

PART 4. ALTERNATIVES ANALYSIS

INTRODUCTION

The purpose of the Alternatives Analysis portion of the ADMP is to further refine the alternatives developed in the Alternatives Formulation part of the study to a level of completion and detail that will allow comparison of the alternatives and selection of the recommended plan.

Not all of the alternatives developed in the Alternatives Formulation portion of the study will be carried forth for analysis in this part of the report. Those alternatives that were rated the highest in the Alternatives Formulation web-based survey were included for further study. Also, where appropriate, the highest rated features of several alternatives were combined to form a new alternative. Likewise, features of the alternatives that rated low in the web-based survey were eliminated from further consideration.

The alternatives selected for further study have been evaluated to a consistent level of detail; sufficient to establish technical feasibility, generalized hydraulics, and conceptual level cost estimates. Even at this level, however, specific alignments and locations of flood control features are not known, and will not be developed until conceptual plans are prepared for the recommended alternative.

At the conclusion of this part of the study are several matrices, which illustrate the evaluation process undertaken and forms the basis for selection of the recommended alternative.

SCREENING OF ALTERNATIVES

The purpose of the screening effort was to select the best combination of features to form three comprehensive alternative plans for the entire study area. The resulting three screened alternatives are comprised of elements chosen from all of the available alternatives as previously described.

Based on conclusions drawn from the web-based survey results, three screened alternatives, shown on Figures 4-45, 4-46 and 4-47 at the end of this section, were selected for more detailed evaluation. Completed descriptions of each of the three alternatives appear in the following sections.

ALTERNATIVES DEVELOPMENT

The three screened alternatives were further developed to verify engineering feasibility and to establish approximate costs. During the alternatives development phase, refinements were made to the location and alignment of facilities resulting from the more detailed analysis. The future condition HEC-1 model, which serves as the basis for sizing and routing flood hydrographs, was revised to reflect the drainage channels, storm drain pipes, and detention basins identified for each alternative. The channel routing parameters and the sequence of hydrograph routing and combinations were modified to model the effects of each alternative.

The detention basins, channels, and pipes were then sized based on the revised 100-year discharges. Detention basins were sized to maximize flow attenuation with the land area available using both off-line and flow through concepts. The off-line concept uses a perimeter channel to allow low flows to bypass the detention basin. The flow-through concept allows the entire flow to be intercepted by the detention basin. Channels and storm drains were sized using Manning’s equation with a hydraulic slope equal to the average ground slope in the reach. If the ground slope was too steep, causing excessive velocities in the channel, a milder slope with drop structures was specified. Culverts were placed at existing road crossings.

The screened alternatives were presented at the third Laveen ADMP Open House held on June 5, 2001. The Open House consisted of a fifteen-minute informational session followed by a number of stations with information on each alternative.

The informational session provided an overview on the alternatives and the ADMP process. At the stations, participants were able to take a close look at each alternative and speak to ADMP personnel about their specific concerns.



Figure 4-1: Laveen ADMP Open House #3 Information Session



Figure 4-2: Laveen ADMP Open House #3 Alternative Station



Figure 4-3: Laveen ADMP Open House #3 Alternative Station



## VISUAL ANALYSIS

Historically, the Laveen Area was a uniquely situated flat sonoran landscape benefiting from flows from the Salt and Gila River floodplains and South Mountain. The topography, in combination with these factors resulted in the deposition of soils and other materials that contributed to making this area suitable for prehistoric and historic agricultural settlement. These settlement types changed the natural landscape character through the addition of irrigation canals and linear vegetation (i.e., row crops) in prehistoric times, and more recently through road building, utilities and development in general.

To understand and document the visual context of the landscape into which the preferred stormwater management plan alternative would be integrated, a visual analysis was conducted for the study area. The analysis evaluated the scenic integrity, visual sensitivity and scenic character of the study area on an approximate one-mile grid, and resulted in the identification of areas with high scenic integrity, which should be considered in the identification of a preferred Area Drainage Master Plan Alternative in the Laveen Area.

In addition to identifying areas of scenic integrity on a one mile grid, the analysis was also conducted along the proposed alignments of the channels and pipes and at the locations of basins proposed in the three Area Drainage Master Plan Alternatives discussed later in this report. The results of this analysis were used in evaluating the benefits and costs of each alternative discussed in later phases of this study.

The Visual Analysis also provided the basis for the identification of elements that form distinct landscape character areas within the Laveen ADMP Study Area. The purpose of identifying these areas is to identify design elements that, if integrated into the design of the preferred alternative, will result in stormwater management improvements that contribute to the visual quality and overall quality of life in the Laveen Area.



Figure 4-4: View of the Laveen Study Area from San Juan Lookout in South Mountain Park (Visual Analysis Point #41).



**Visual Analysis Methodology**

The Visual Analysis was conducted on one mile grids and at one mile intervals throughout the study area. The U.S. Forest Service Visual Analysis methodology was considered in conjunction with other studies to develop visual analysis criteria appropriate to the Laveen Area. The three elements scored in the analysis were landscape character, scenic integrity and visual sensitivity. A description of each of these elements is below. The combined scoring in this analysis resulted in a ranking, which identified areas with landscapes that should be conserved or could be positively or negatively impacted by proposed stormwater management facilities.

**Visual Analysis Elements**

*Landscape Character* Area designates an area of land that has common distinguishing man made or cultural features and the scarcity, density, and scale of those features. Features considered in this analysis included landform, rock formation, surface water, vegetation patterns, cultural or man made structures or features and adjacent scenery.

Areas with a strong landscape character include common and distinguishing features (such as the lines in the following photos formed by rows of crops, fences, shade structures, irrigation canals, roads, and field edges), colors (browns and greens) and landform (flat).



Figure 4-5: Strong landscape character



Figure 4-6: Strong landscape character

*Visual Sensitivity* is the degree of harmony among the features of an area with regards to line, color, form, texture, land form, vegetation, architectural features and streetscape compatibility. Opportunities to increase visual integrity represent opportunities to harmonize discordant features. This category is rated from very high to unacceptably low.

*Scenic Integrity* refers to the distinctiveness, visual dominance (scale/ color/ form), or a variety of features within an area. Features of high scenic quality are distinctive or unique and should be protected. The distinctiveness or uniqueness of features include consideration of the mystery, vividness, intactness, coherence, harmony, pattern, balance, form, line, color, and texture of the landscape. Improving scenic integrity can be done through restoring the original or historic variety of vegetation or/and natural or manmade features. The extent of human caused deviation in form, line and color and texture that has occurred in the landscape is considered here.

Figure 4-7 demonstrates an area that has a high degree of scenic integrity. The riparian vegetation is dense and is unique and draws the observer in (creating a sense of mystery). There is a high degree of contrast in the colors, heights, and textures of the vegetation. The landscape is intact and undisturbed



Figure 4-7: High scenic integrity

**Visual Analysis/ Ranking**

Visually, the study area has some of the highest quality areas between the Salt River, South Mountain, Central Avenue and the Gila River Indian Community Boundary. Fifty percent of the top ten ranked analysis stations for visual quality and almost 70% of the top 50% of the stations ranked for visual quality are within the study area. The analysis stations are documented on Figure 4-11, Visual Assessment Working Map.

The top ranked station for overall visual quality is the Dobbins Overlook in South Mountain Park and is outside of the study area. The second ranked station, also within South Mountain Park and within the Study Area, is the San Juan lookout. The next six top ranked stations, half of which are in the study area, are located at high points on the Carver Hills and South Mountain Foothills.

The next group of viewpoints ranked high for overall visual quality are mostly located between South Mountain and Carver Hills. These areas were found to have visual quality because of the dramatic setting between the Carver Hills and South Mountain, or in the case of areas in South Mountain Park, because of their scenic integrity.

Areas ranking in the mid-range for overall scenic quality fall almost entirely within the study area. These areas are mostly in the flat, agricultural areas and along the undeveloped portions of the Salt River. These areas included features such as historic and agricultural structures, canals, and riparian vegetation.



The areas ranked at the bottom third for visual quality include those areas that have industrial uses or are being developed. Most of these areas are located outside the Study Area.

Station 44 located at the southeast corner of the Study Area, ranked within the top ten for overall visual quality due to its high visual sensitivity and scenic integrity.



Figure 4-8: Visual Analysis Station 44

Station 34, looking east towards the Carver Hills, was ranked in the midrange for overall visual quality.



Figure 4-9: Visual Analysis Station 34

Table 8: Visual Analysis Rankings

Visual Analysis Assessment Rankings		
Station #	Total (averages)	Rank
35	69.33	1
41	67.33	2
39	63.83	3
30	63.25	4
32	59.33	5
44	58.33	6
36	58.00	7
31	56.67	8
23	56.00	9
38	54.67	10
37	54.33	11
21	53.63	12
42	53.00	13
19	52.00	14
40	51.67	15
26	50.25	16
27	49.00	17
10	48.50	18
5	48.33	19
33	48.25	20
29	47.33	21
18	47.25	22
22	47.00	23
9	46.00	24
11	46.00	25
24	46.00	26
34	45.17	27
16	44.67	28
14	44.17	29
20	44.00	30
17	43.75	31
25	43.67	32
15	41.00	33
6	41.00	34
4	40.76	35
28	40.75	36
7	40.33	37
13	40.25	38
12	36.33	39
8	35.67	40
1	32.50	41
3	29.67	42
2	29.00	43

Station within Laveen ADMP Study Area

This ranking is attributed to the largely undifferentiated foreground and mid ground accented by the background views of Carver Hills.

While not in the Study Area, visual analysis station 1 was lowest ranked for overall visual quality. The natural landscape is obscured, the fore, middle and background are unremarkable, and the features of the landscape are cluttered and undistinguished.



Figure 4-10: Visual Analysis Station 1



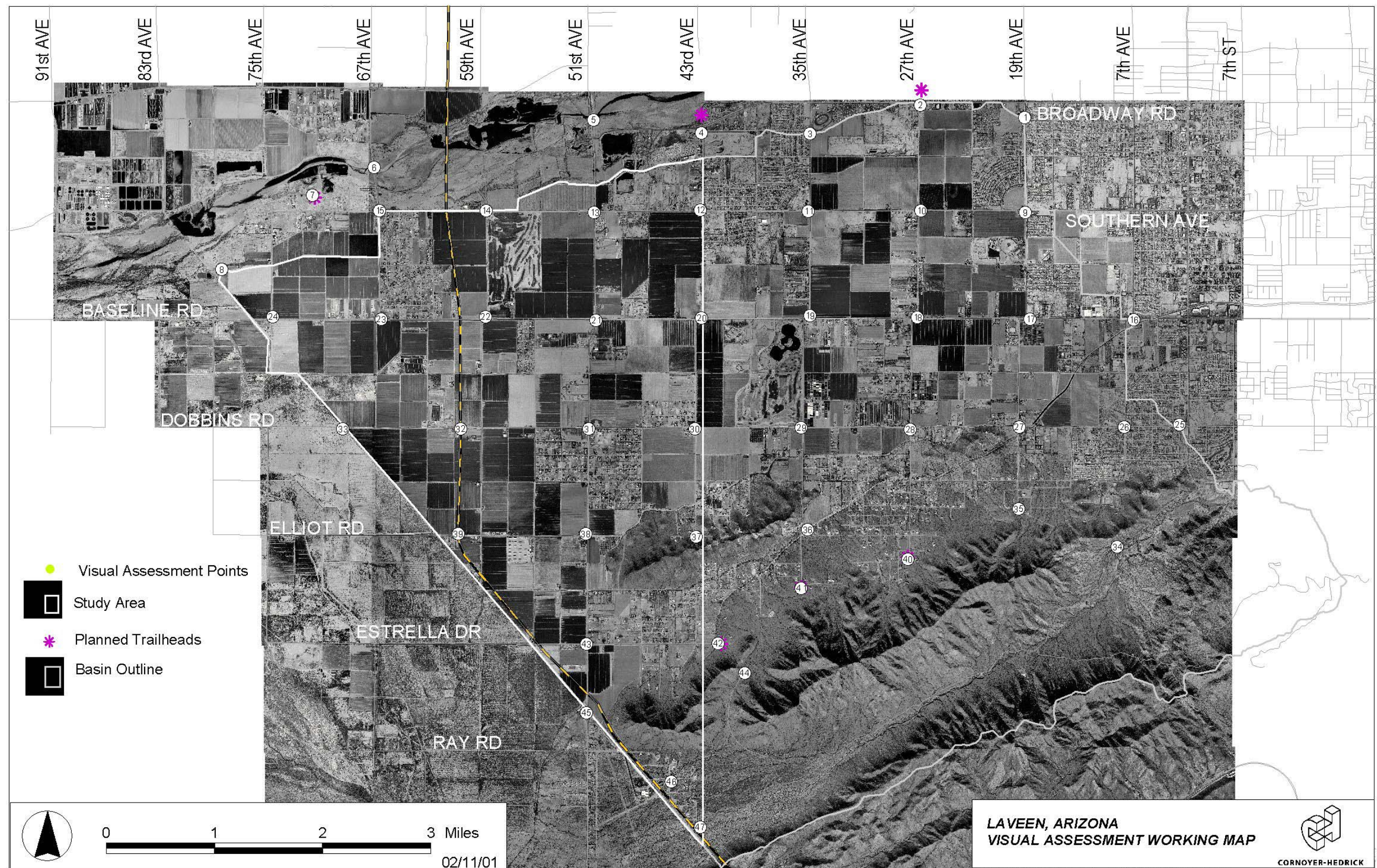


Figure 4-11: Visual Assessment Working Map



***Landscape Character Areas***

In order to ensure that the preferred Area Drainage Master Plan alternative is implemented in a manner that is appropriate to the visual and physical character of the community, a landscape character analysis was conducted. This analysis identified common land and building forms and textures, and landscapes that create specific landscape character areas. The integration of these elements into the implementation of the preferred alternative will substantially contribute to it’s harmonious integration into the Laveen Area.

The Laveen Area is typified by four landscape character areas Natural Desert, Agricultural, Transitional and Urban. These areas are identified in Figure 4-21: Laveen ADMP Landscape Cultural Areas. Each of these areas has specific characteristics and is discussed below.

*Natural Desert*

The Natural Desert Landscape Character Area is located on the slopes of South Mountain within the Study Area and the Carver Hills. This landscape character unit is typified by dramatic, sloping topography, low, loose vegetation, a rough texture and a primarily brown color palette.



Figure 4-12: Natural Desert Landscape – loose vegetation



Figure 4-13: Natural Desert Landscape – steep slopes, brown color palette, rough texture

*Agricultural*

The Agricultural Landscape Character area is mostly located in the area between the Salt River and South Mountain, excluding the Carver Hills. These areas are mostly interim use farms and feed lots. While this landscape is typical of the recent history of the area, the proximity of Laveen to downtown, Central Phoenix, and South Mountain the planned construction of the southwest loop, and the dramatic mountain views has attracted new residents to the area. Current residents are most concerned about the loss of the agricultural landscapes, lifestyles and character of Laveen, and are working with the City of Phoenix to develop trails, standards and development patterns that will preserve elements of the agricultural landscape and lifestyle for future residents.



Figure 4-14: Agricultural Landscape – crops

The agricultural landscape character areas in Laveen include a variety of development types. Strong geometric lines (which stand in stark contrast to the organic forms of the Natural Desert Landscape Character Area in the background of the previous photograph) take the form of crops, roads, telephone, power, and fence lines, irrigation canals and structures, such as silos or shade structures for cattle.



Figure 4-15: Agricultural Landscape - telephone, power lines



Figure 4-16: Agricultural Landscape – fence lines



Figure 4-17: Agricultural Landscape – irrigation canal, silo



Urban

The Urban Landscape Character Areas are those places that include residential subdivisions, large single use buildings (such as high schools) and commercial development.



Figure 4-18: Urban Landscape



Figure 4-19: Urban Landscape

These areas are typified by geometric forms placed at regular interval (such as square and rectangular buildings, triangular roof tops, curved roadways) an organized landscape pattern focused around structures, and a variety of managed vegetation.



Figure 4-20: Urban Landscape Character

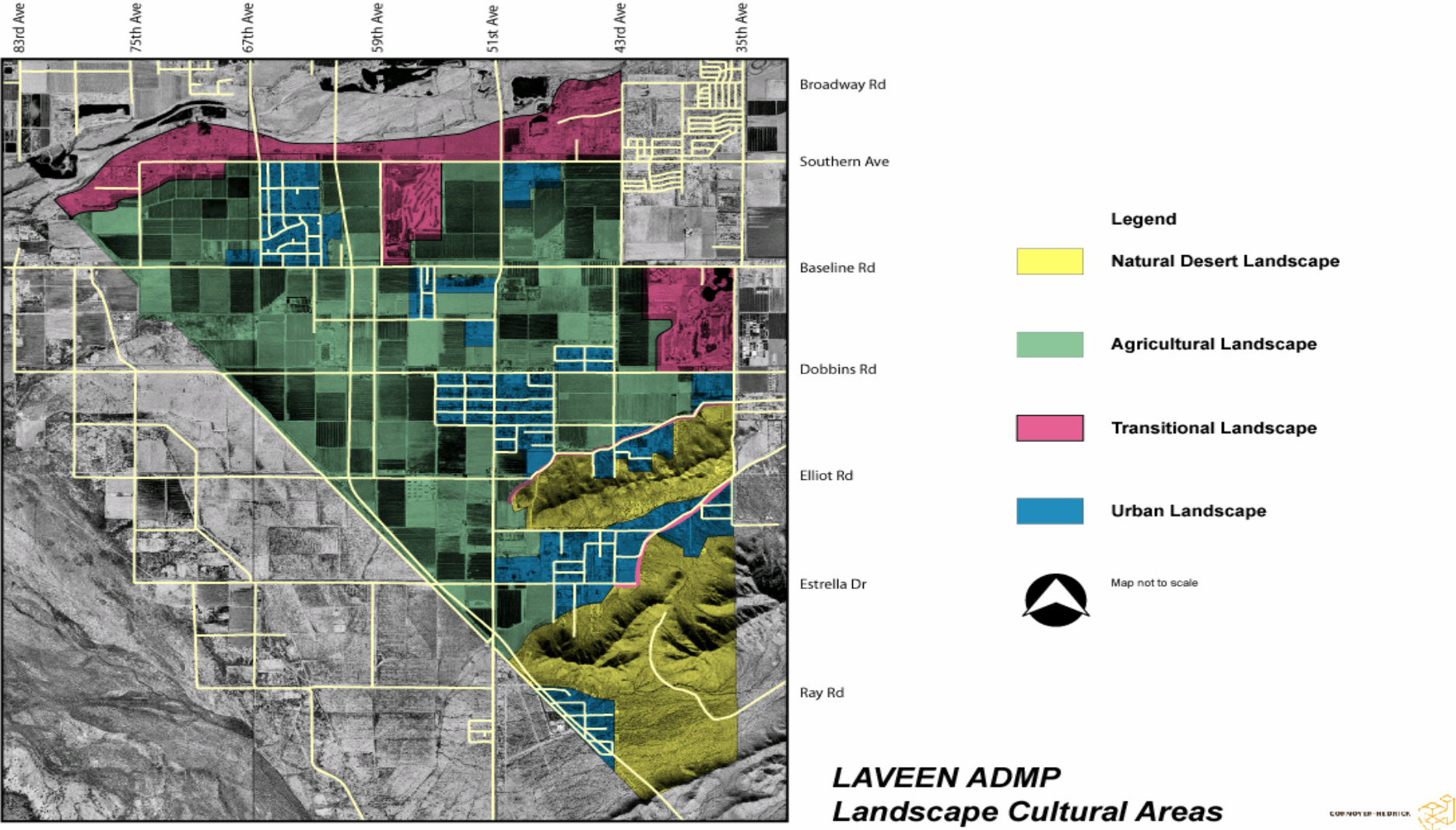


Figure 4-21: Laveen ADMP Landscape Cultural Areas

Urban Landscapes include a variety of geometric forms placed at regular intervals. In Laveen, these areas are located around new development occurring along Baseline Road west of 35<sup>th</sup> Avenue, and in the valley between Carver Hills and South Mountain.

Transitional

The Transitional Landscape Character Areas are those places that include elements of the agricultural, natural desert and urban landscapes.

In the Laveen ADMP study area, these places are either golf courses, which provide many of the elements of the agricultural landscape in an urban landscape format, or along the Salt River where mining and other industrial uses are juxtaposed with natural landscapes.

The colors and linear elements of fences and trees blended with the very regular spacing and sculpted landform create a transitional character for the golf course landscapes.



Figure 4-22: Transitional Landscape



**Landscape character thematic concepts**

Landscape character thematic concepts were developed from the four landscape character areas. The purpose of the thematic concepts is to provide options for visually and culturally integrating the preferred alternative into the Laveen Area.

*Natural Desert Landscape Theme*

This thematic concept is appropriate in the southern portion of the study area at South Mountain Park and in the Carver Hills area. Although residential development and some mining operations are located around the boundary of the park, minimal man-made disturbance has occurred within this theme area and the native sonoran desert plant community is thriving. Additionally, the scale and height of development in these areas have not impacted the views of the mountains from other areas. The vegetation in the Natural Landscape Desert Character Area and Theme is moderately to highly varied. Within this landscape theme, saguaros and ocotillos provide line and form; the chollas, rock outcroppings and yuccas provide texture. Shrubs and trees provide seasonal color and dominate the fore and middle ground. This is the area where natural water flow has not been impacted, and within this character area, natural flows are maintained or restored to the greatest extent possible.

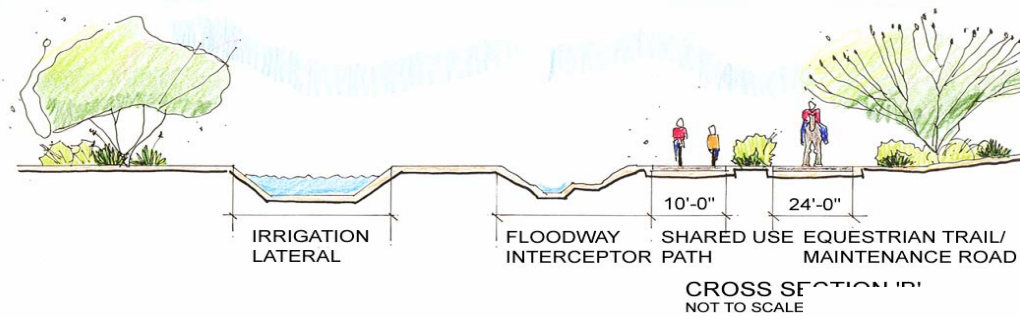


Figure 4-23: Natural Desert Landscape Theme applied to an irrigation lateral (section)

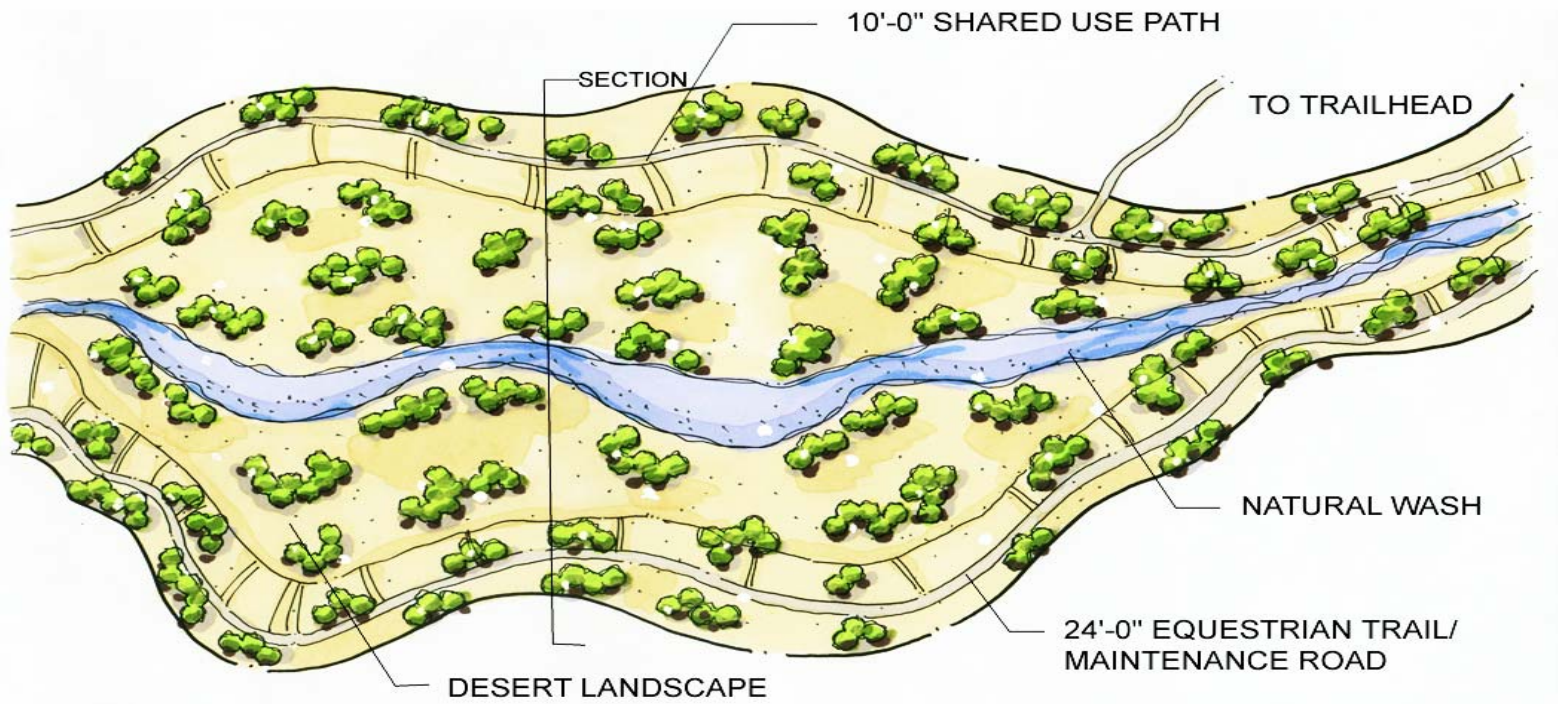


Figure 4-24: Natural Desert Plan for detention basin

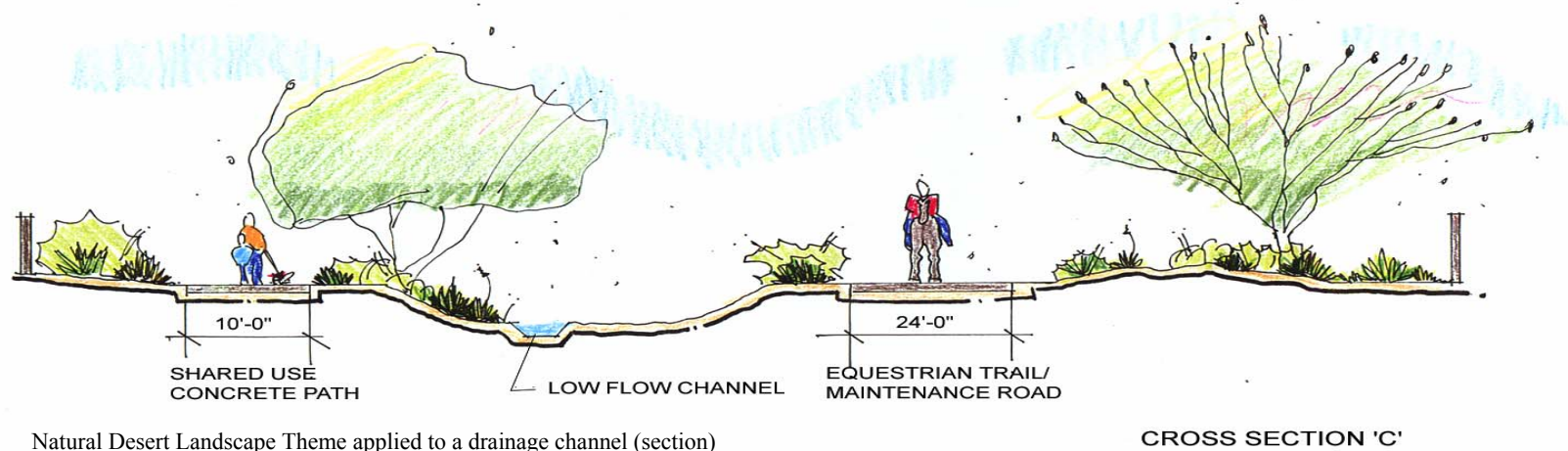


Figure 4-25: Natural Desert Landscape Theme applied to a drainage channel (section)

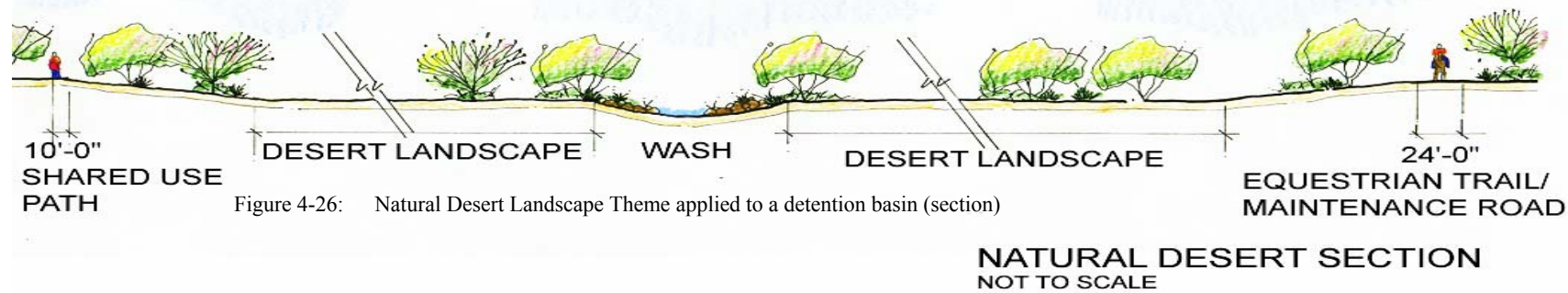


Figure 4-26: Natural Desert Landscape Theme applied to a detention basin (section)



*Agricultural Landscape Theme*

The predominate land use in the Laveen ADMP study area is in active or fallow agriculture. This landscape theme reflects human modification of the natural desert with agricultural fields, scattered farm buildings and grain silos. Formal rows of crops create mono diversity of color, texture and lines in entire sections of land. These patterns change with the planting season. Agricultural fields are square or rectangular in form, and they have been graded almost level to accommodate irrigation applications. Arterial streets and irrigation canals also methodically enforce this grid and maintain the minimal slopes in these areas. Several high voltage overhead power line corridors traverse the study area and they dramatically interrupt the skyline in an otherwise horizontal landscape. Vertical lines and forms are found at farm buildings with coarse textured, windbreaks, green shade trees, palms and scattered outbuildings and barns. The 360-degree panoramic views are maintained in these areas because of the scale and height of this development. Natural water flow in this area has been replaced by canals and ditches, which have a very rigid and geometric form and create distinct lines in the landscape. With all geometric elements the eye looks up or down the canals, streets and overhead power lines toward the axis or vanishing point, the mountains. The agricultural landscape character theme re-creates this character through the use of linear patterns and shapes, flat landforms, and consistent vegetation types.

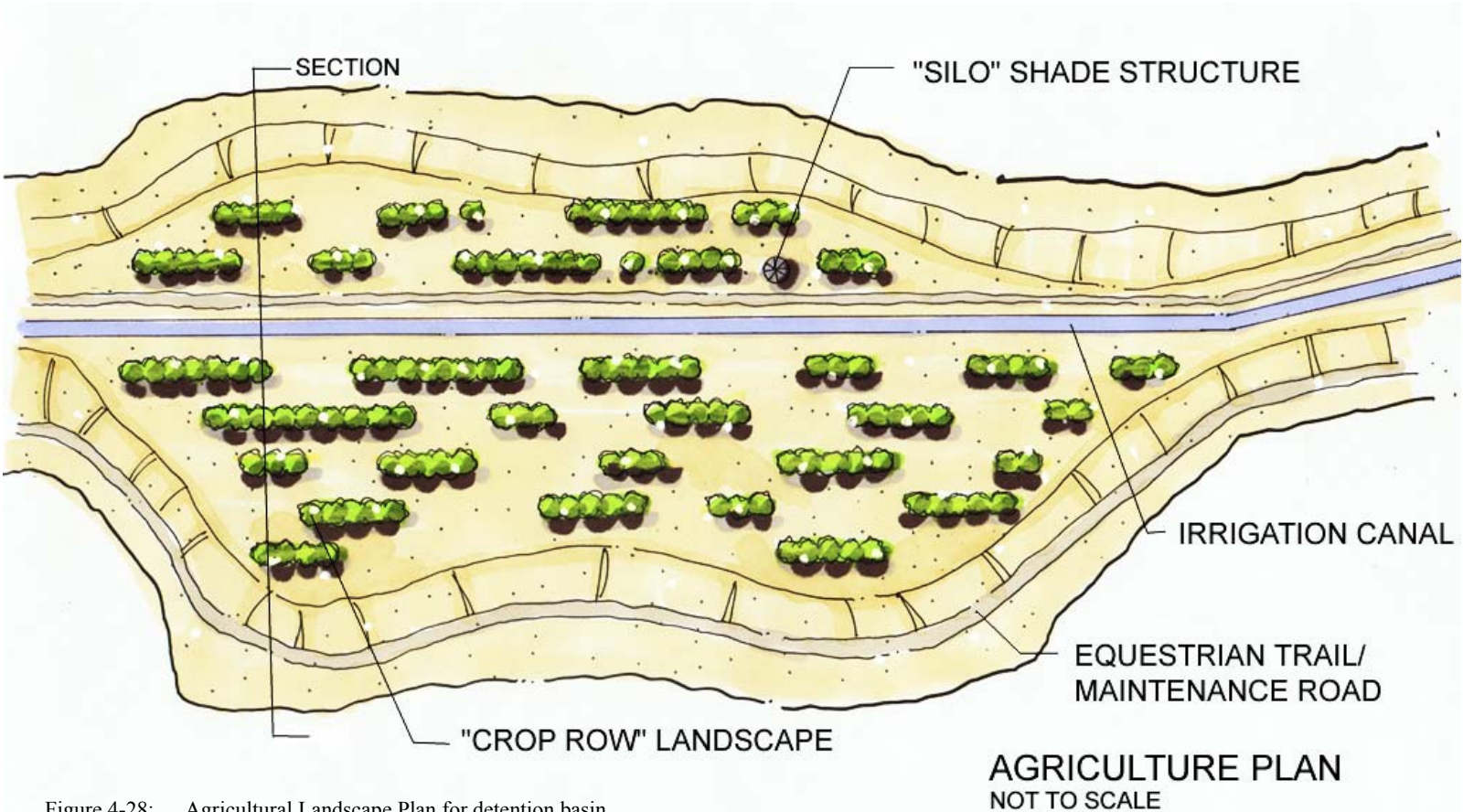


Figure 4-28: Agricultural Landscape Plan for detention basin

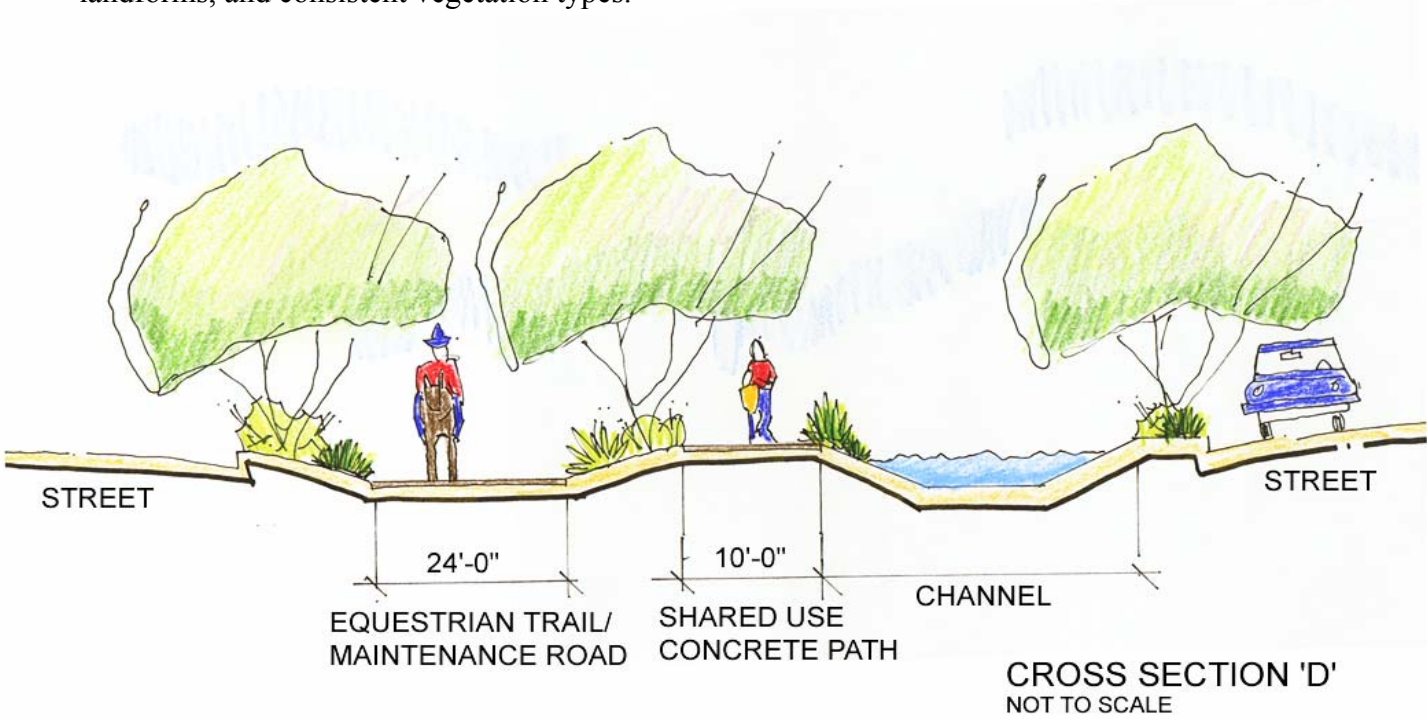


Figure 4-27: Agricultural Landscape trail adjacent to a drainage channel (section)

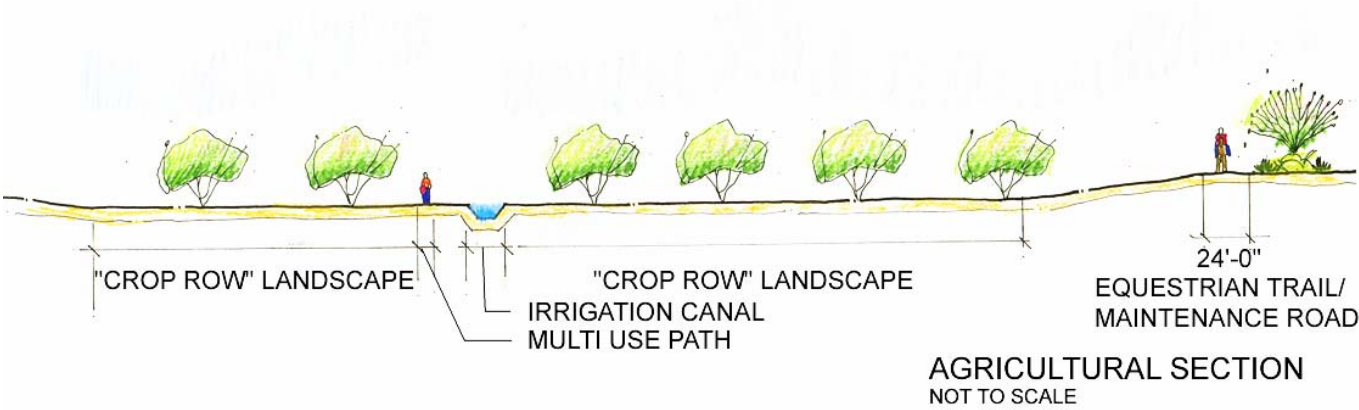


Figure 4-29: Agricultural Landscape applied to detention basin (section)



Urban Landscape Theme

Elements that are included within this Landscape Character Area are residential, commercial and industrial applications. The one-mile grid of the street system, irrigation canals and subdivision walls dictate land development patterns and therefore creates dominant line and form within the landscape.

Also affecting line and form in this area are several high voltage overhead power line corridors traversing the study area. Vertical lines and forms are found at the edges of development and at the high voltage power line corridors. The 360-degree panoramic views are maintained in these areas because of the scale and height of this encroaching development.

Most utilities and canals have been placed underground reducing the amount of geometric elements that affect vanishing points and the rigid formality that is associated with them. The parks and golf courses have green, fine textured open play tees and fairways, fine to medium textured shade, desert accent trees in informal to formal planting schemes, and medium to rough texture at the perimeters and in the rough.

The landscape character and the visual perception in the urban area are the most varied of all of the landscape theme areas. The scenic integrity including variety, unity, vividness, mystery, intactness, coherence, harmony, uniqueness, pattern, balance, form, line color and texture is the greatest in the urban landscape area. The urban landscape themes include formal plantings, managed circulation systems and strong geometric forms. Color and texture are carefully managed to be appealing in high use areas. A variety of plant materials is included in this theme.



Figure 4-30: Urban Landscape plan for detention basin

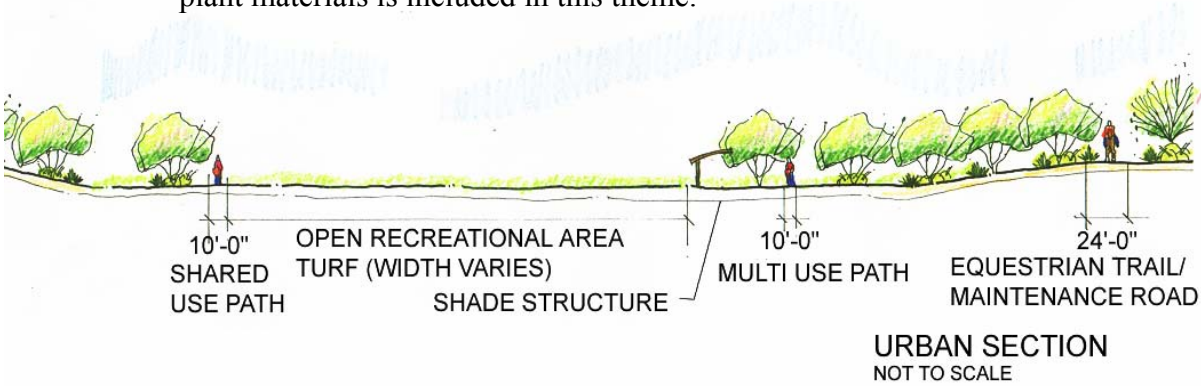


Figure 4-31: Urban Landscape applied to detention basin (section)



*Transitional Landscape Theme*  
The transitional landscapes in Laveen occur along the river and in areas that include a mix of character elements, such as golf courses. In the implementation of the preferred alternative, the transitional theme is recommended for the edges of each landscape character area as well as in parks, golf courses, schools, along the banks of the Salt River and public facilities. Many of these areas are framed by development and associated perimeter walls and overhead power lines. This landscape theme includes a mixture of all of the lines, forms, colors; textures associated with the natural desert, agricultural and urban landscape character areas and functions as a connection to ‘glue’ together landscapes of different characters.

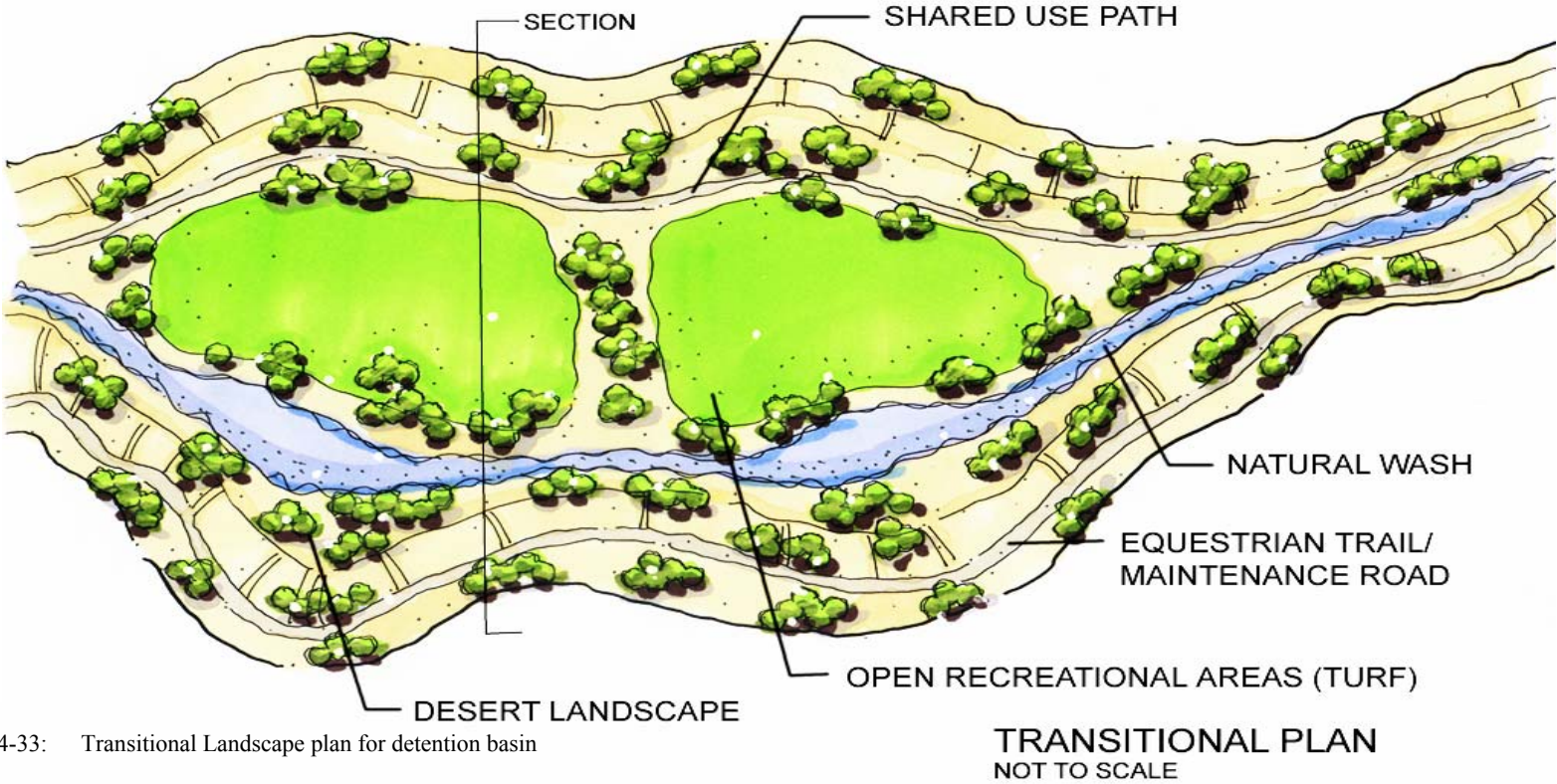


Figure 4-33: Transitional Landscape plan for detention basin

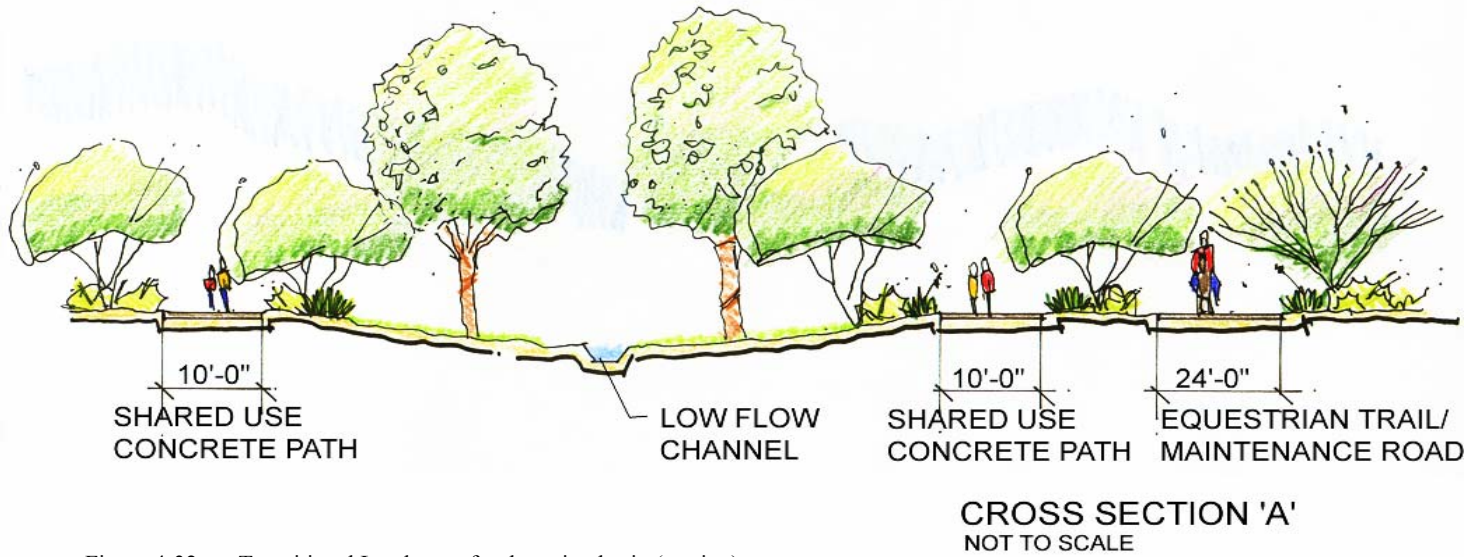


Figure 4-32: Transitional Landscape for detention basin (section)

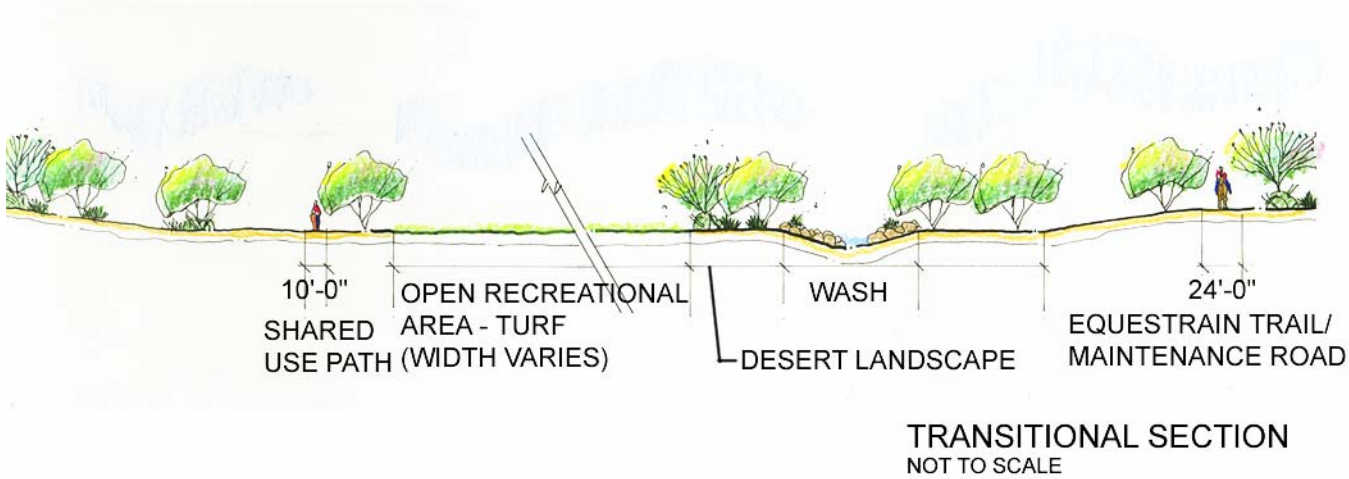


Figure 4-34: Transitional Landscape for detention basin (section)



**BENEFITED AREA ANALYSIS**

All of the alternatives developed in this section of the ADMP will provide flood protection to homes, commercial buildings, and agriculture, which are currently susceptible to inundation and inconvenience. Based on existing and future zoning information, the areas prone to this type of flooding amount to approximately 4100 acres. Figure 4-35 illustrates the areas that are most commonly flooded during a major storm event and that will be protected under each alternative.

**Land Classification**

The flood prone areas were classified based on land use categories. Using GIS tools, the acreage within each category was estimated. Tables 9 and 10 list this information for existing and future land uses.

Table 9: Acreage by land use category for Existing Zoning

Land Use Category	Acres
1-2/acre Res	621
2-5/acre Res	18
Agriculture	3055
Industrial	319
Neighborhood Retail Center	1
TOTAL	4014

Table 10: Acreage by land use category for Future Zoning

Zone Type	Acres
0-1 units/acre	1268
0-2 units/acre	873
2-5 units/acre	1132
5-10 units/acre	192
10-15 units/acre	31
Commerical	255
Commerical/Business Park	433
TOTAL	4184

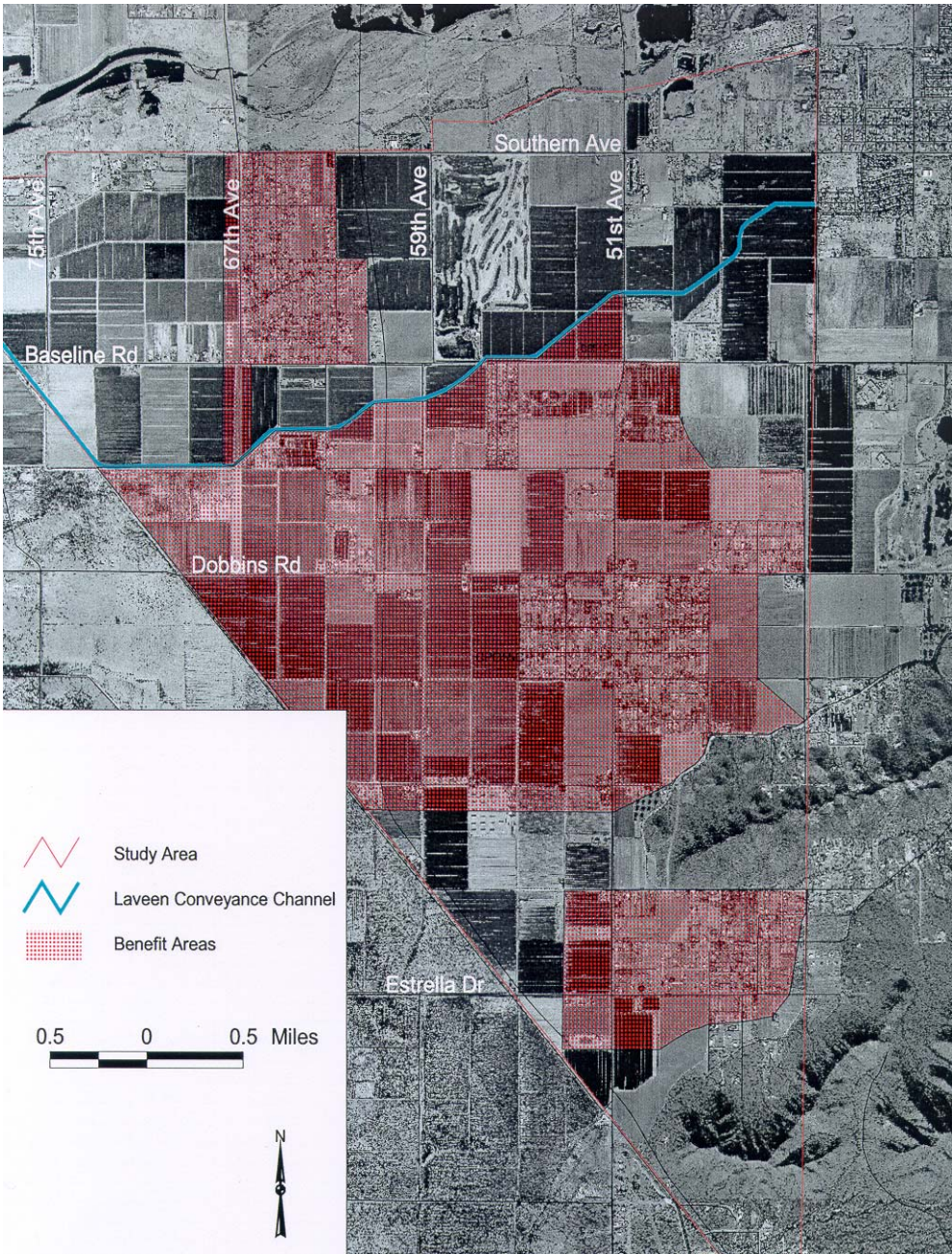


Figure 4-35: Areas Prone to flooding

**Property Valuation**

Average dollar values for the structures within the different categories were obtained from various sources. For residential structures, the value was assessed using existing realty data and information obtained from the Maricopa County Assessor’s Office. The following table summarizes the average value for residential structures within each zoning category. A considerable range exists for structure values within each category and the average value may not be representative of any particular structure.

Table 11: Average property value for residential zoning type

Zone type	Average value per duelling unit (\$1000s)
0 – 1 due/acre	\$315.75
0 – 2 due/acre	\$250
1 – 2 due/acre	\$285
2 – 5 due/acre	\$154
5 – 10 due/acre	\$100
10 – 15 due/acre	\$50

The value of commercial structures, as well as agricultural land, was adapted from existing studies for the area of Tres Rios, AZ located just northwest of the Laveen ADMP study area. For agricultural land use, it was assumed that all crops were based on crop prices for cotton, for 1998 (Tres Rios Feasibility Report. USACE, April, 2001).

**Depth to Damage Curves**

According to USACE Economic Guidance Memorandum 01-03, *Generic Depth-Damage Relationships*, the methodology for estimating flood damages is a standardized process. The process involves the use of generic depth/damage relationships developed by the Federal Emergency Management Agency (FEMA) in conjunction with a real estate survey of all the structures within the area including their contents, and frequency/discharge and frequency/depth hydrologic models. The generic depth/damage functions provide an estimate of the losses due to depth of flooding above the first floor elevation of a given structure.



Table 12 represents an excerpt of the depth/damage function according to the Flood Insurance Rate Reviews for 1997 of the National Flood Insurance Program’s Actuarial Information System.

Table 12: Depth/damage function for residential structures

Level of flooding above first floor (ft)	Damage percent to residential structure not including mobile homes
-0.5	8%
0.0	16%
0.5	16%
1.0	16%
1.5	21%
2.0	25%
2.5	26%
3.0	28%
3.5	29%
4.0	30%
4.5	30%
5.0	31%

For example, in an event where a residential structure is flooded to 1 foot above the first floor, there will be an estimated damage of 16% of the value of the structure. This does not include the content value which will obviously add to the amount of losses. Other functions exists where these losses are accounted for (furniture, carpet, etc). For this study, this value was not incorporated since a valid estimation would require more detailed survey information. From the previous table, it can be observed that the damage due to 3 inches, 6 inches, and 9 inches of flooding above the 1<sup>st</sup> floor of a home results in the same average loss or damage to a structure.

This information was used to estimate the extent of damage for the Laveen area due to flooding at various depth levels. Figures 4-36 and 4-37 illustrate the losses due to flooding for existing and future zoning types.

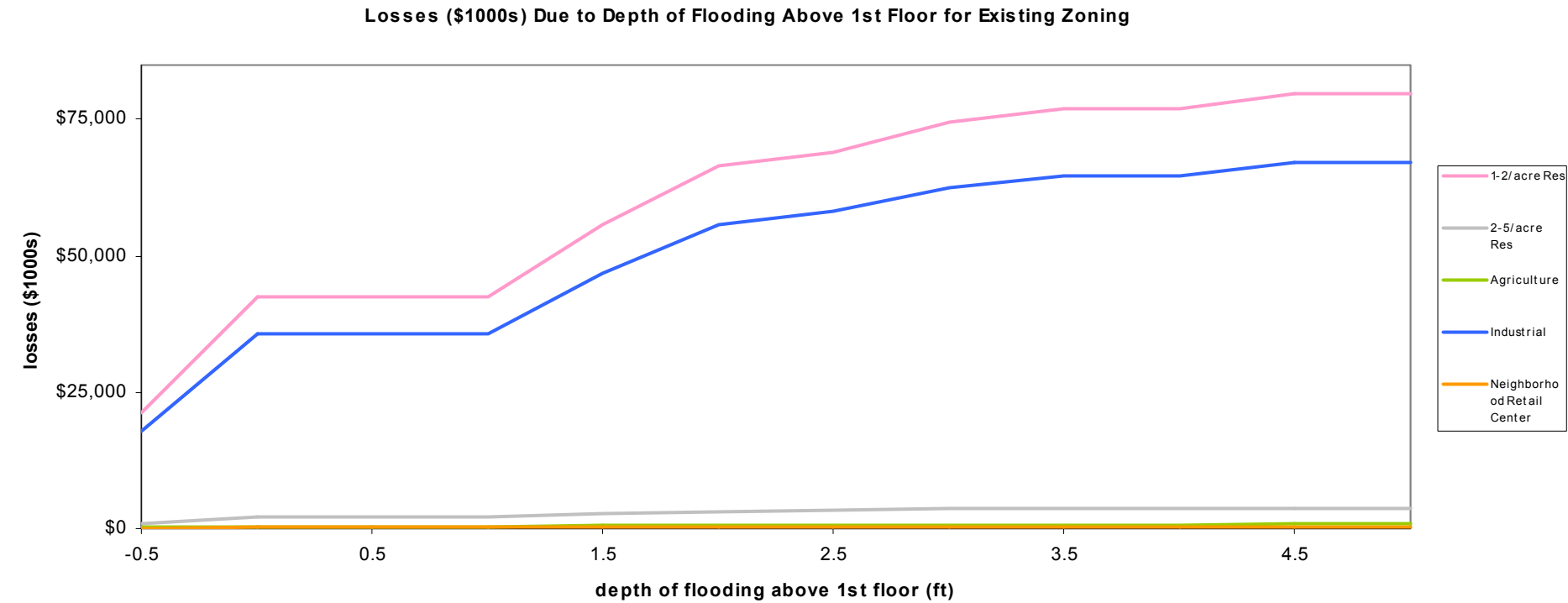


Figure 4-36: Losses to structures due to flooding above 1<sup>st</sup> floor for Existing Zoning

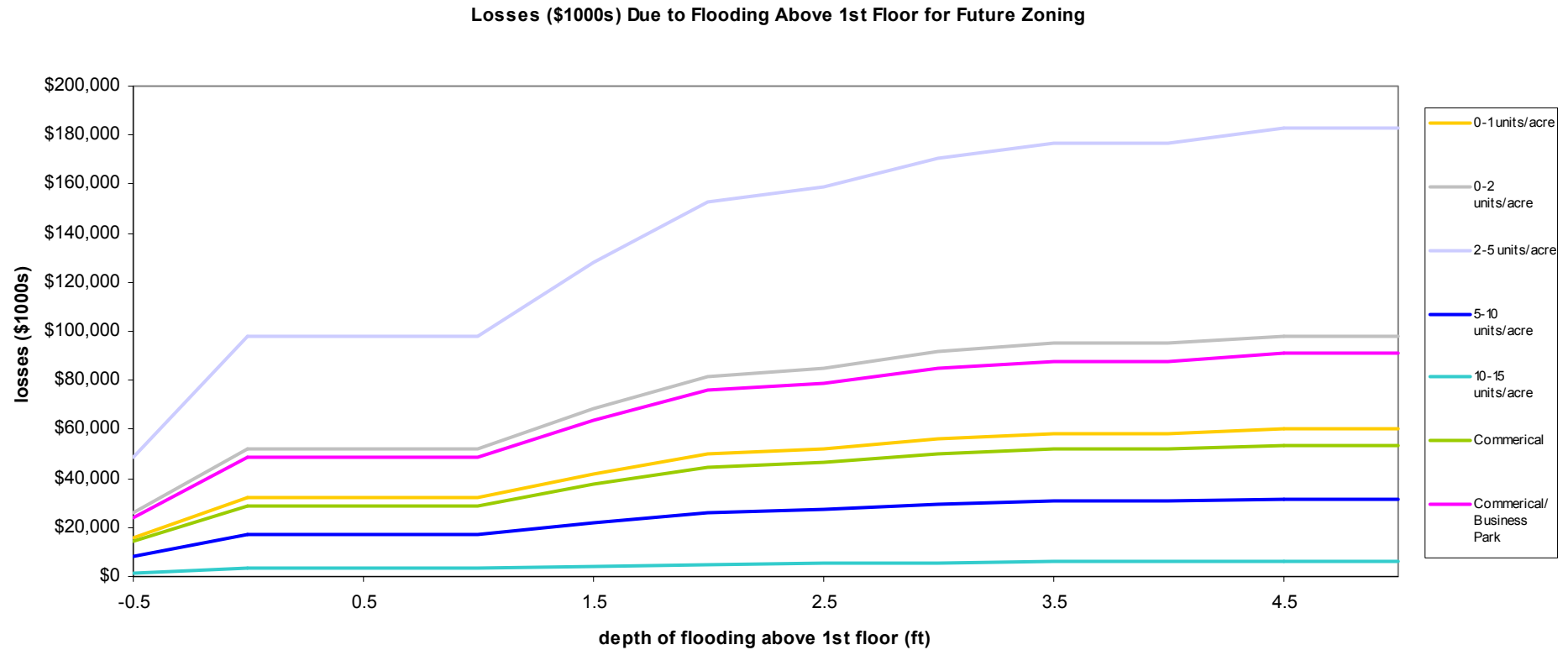
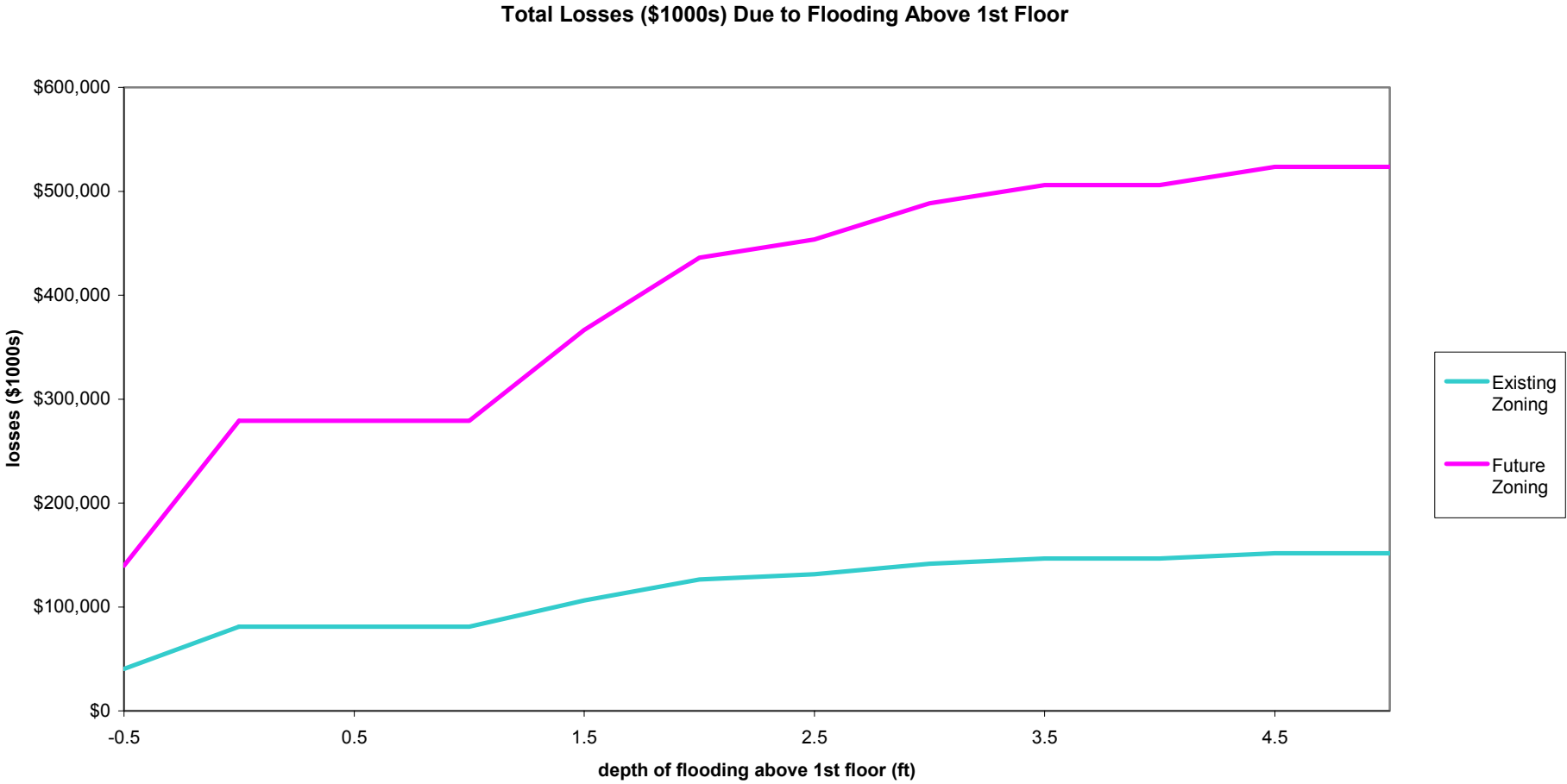


Figure 4-37: Losses to structures due to flooding above 1<sup>st</sup> floor for Future Zoning





As future zoning plans develop within the Laveen area, more residential and commercial structures will be present. The total property value in Laveen will increase as will the losses due to flooding. For an event that results in 3 to 12 inches of flooding above the first floor of residential structures in the area, an approximate increase in losses of about \$198,000,000 can be estimated when comparing existing land use and future land use (from \$80,884,000 worth in losses in the existing land use plan to \$279,184,000 in the future land use). These losses may be prevented with the flood control alternatives in place.

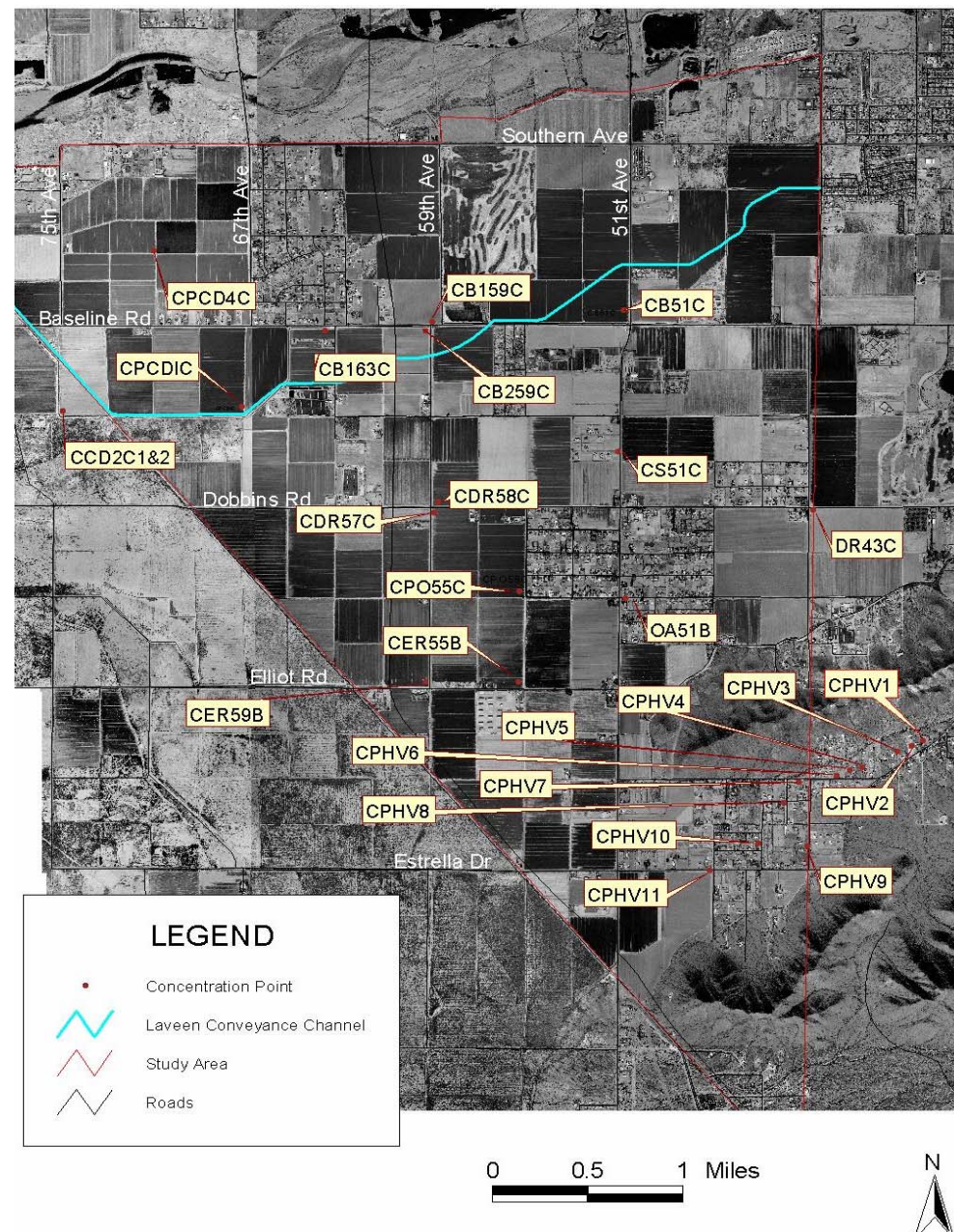
In addition, it can be observed that even when the depth of flood resulting from a major storm event is not above the 1<sup>st</sup> floor elevation, structural damages are evident and quantifiable. This fact is critical for the Laveen area since documentation of flooding above the floor level of structures may not be readily available.

***Hydrologic Models***

The HEC-1 hydrologic models in Appendices D, E, and F were used to predict the depths of flow that may be observed at various concentration point locations within the Laveen ADMP study area under existing conditions, future conditions, and for each of the three alternatives.

Figure 4-38: Total losses to structures due to flooding above 1<sup>st</sup> floor





It is important to note that a complete hydraulic model for each of the above noted conditions would be required to accurately predict depths of flow, and therefore depths of flooding. The hydrologic models simply report stormwater runoff rates and volumes. The rate and volume information was summated at the locations indicated on Figure 4-39, and depths of flow estimated as shown in Figure 4-40.

It is not possible, by this method, to predict depth of flooding at any specific dwelling unit or parcel of land within the study area. Only at the major concentration points, where conveyance of the storm flows within a defined path can be demonstrated, has a flow depth been predicted. These predictions are shown for purposes of comparing alternatives and cannot be used for actual flood damage assessment work. For the center portion of the study area, towards the Laveen town core, a reduction of approximately half of the expected flows is also observed. This area includes the Laveen Elementary School, which has historically been an area of concern. For this portion of the study area, the greatest reduction in expected flows and corresponding volume is observed.

The only point within this portion where a reduction of flow for all alternatives is not consistent, is at 51<sup>st</sup> Avenue and Olney (south of Dobbins Road). At this point, Alternatives 2A and 4 greatly reduce the flow and volume, whereas Alternative 6 shows a reduction to about half of the original flow but is still much greater than the flows expected with the any of the other alternatives in place.

For Hidden Valley Watershed, a similar reduction of flows is observed with all three alternatives in place. The areas in the southern portion of the watershed will benefit from a reduction of expected flows to approximately half of the flows that would be observed in both existing and future conditions.

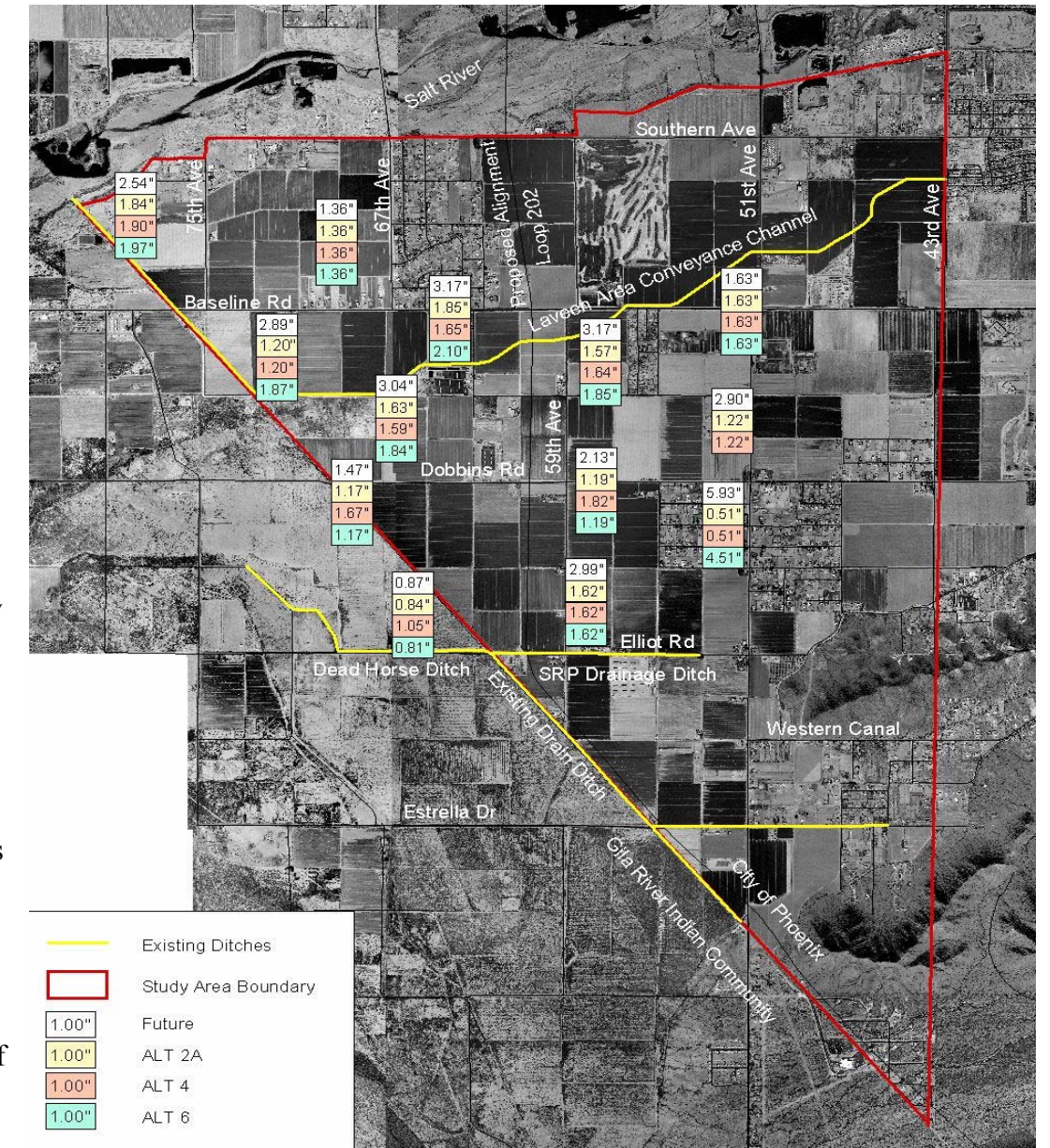


Figure 4-40: Depth of flooding at concentration points



## DESCRIPTION OF ALTERNATIVES

The alternatives chosen for further evaluation are described in this section. The cost for each alternative is summarized at the end of the section in Tables 13 through 15. The total cost includes a 30% contingency on the construction cost which will account for engineering design, construction administration, environmental issues such as 404 permits, cultural resources surveys and hazardous waste surveys, and other minor detail items. Figures 4-45, 4-47, and 4-49 show the plan elements, descriptors, and the detailed cost estimate breakdowns for each alternative.

Each alternative assumes that the Laveen Area Conveyance Channel has been constructed and will be treated as an “existing condition”. This is both for the engineering purposes of intercepting and conveying flood flows, as well as for the visual analysis purposes of integrating with the existing landscape and character of the region

### Alternative 2A

#### Estimated Cost

The estimate cost of Alternative 2A is \$31,157,257. Additional costs may be incurred with the incorporation of multi-use infrastructure, which would be funded by organizations other than the District. Refer to Table 13 for a detailed explanation of the estimated costs.

Alternative 2A includes a detention basin, pump station, and storm drain that provide flood protection for the Gila River Indian Reservation. The other alternatives do not provide protection for the GRIC. Without these elements, the cost of Alternative 2A is \$21,121,361.

#### Description

Alternative 2A is similar to Alternative 2 as presented earlier in this study, however it has been modified to incorporate some of the more effective features of Alternatives 1 and 3. Alternatives 1, 2, and 3 all received similar scores on the web-based survey and the most desirable features were easily incorporated into one combined alternative.

Conveyance of the 100-year flood flows in Alternative 2A is mainly achieved above ground in open, multi-use drainage channels. The channels will be relatively wide, with gentle side slopes, and vary in landform and theme throughout their lengths. Sizes of the multi-use drainage channels will be somewhat reduced by the placement of

detention basins at strategic locations within the drainage channel system. Detention basins will serve to attenuate peak flows, thereby limiting the required conveyance capacity needed in each channel. The detention basins will also serve as important nodes in the multi-use system. They may be used as trailheads, equestrian centers, ballparks, soccer fields, etc.

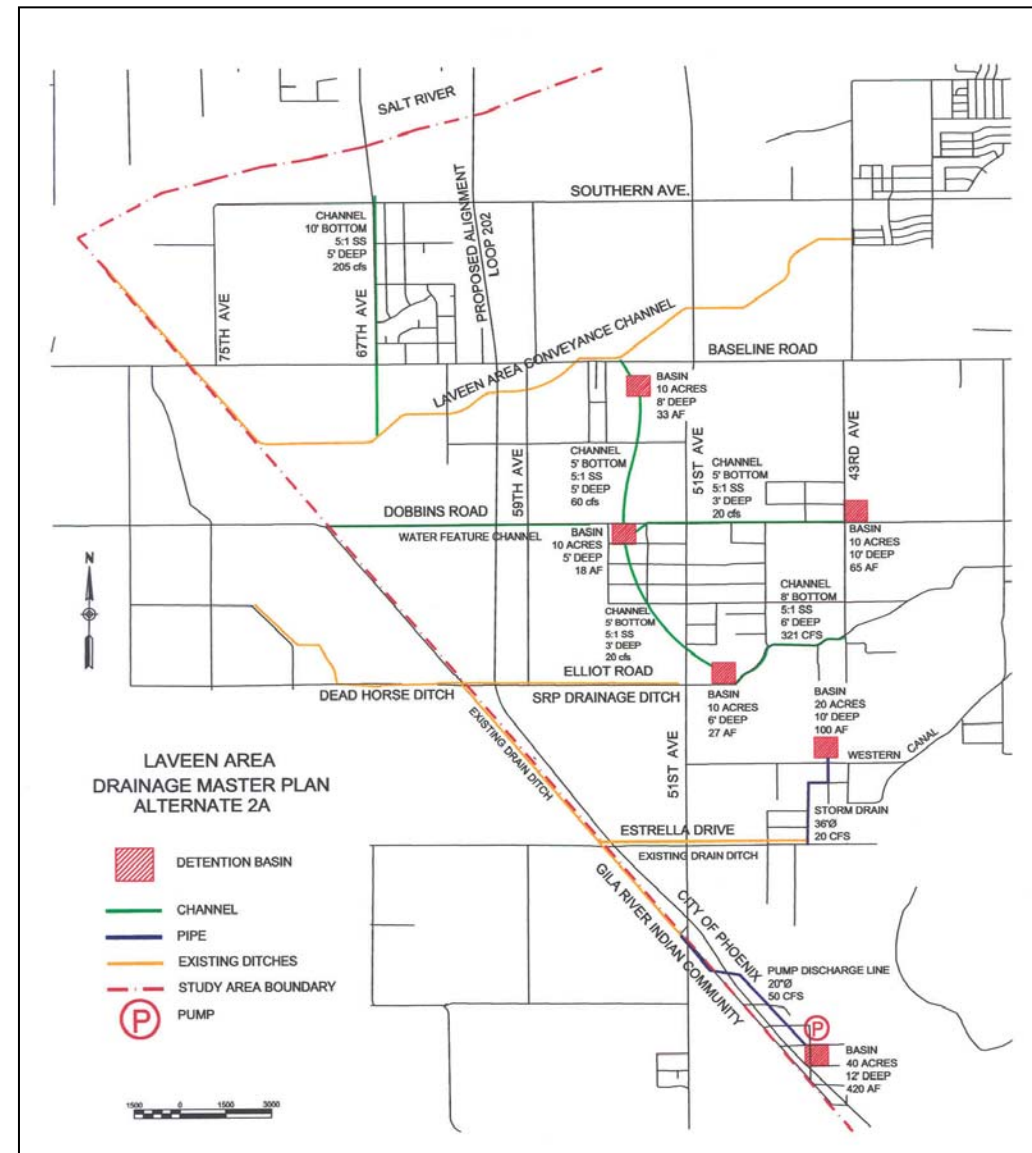


Figure 4-41: Alternative 2A, “Break the Grid”

Some of the main elements of Alternative 2A are:

- Including as much as possible the recommendations found in the Laveen Watercourse Master Plan. A meandering channel provides for north/south conveyance of storm flows generally along 51<sup>st</sup> Avenue. Also, a waterway feature through the town

core may be provided. The water feature would serve no purpose for flood control, but would provide for connectivity of a trail system and other multi-use elements through the planned town core.

- An open, multi-use channel along Dobbins Road flows west from a detention basin at 43<sup>rd</sup> Avenue, and ultimately drains to a detention basin near 51<sup>st</sup> Avenue.
- Multi-use flood channels for the Western Canal and Telegraph Pass to control stormwater and convey it westerly. Right-of-way for the channels will allow for equestrian and other users
- A detention basin to be located at 51<sup>st</sup> Avenue and Dobbins will be incorporated into the town core and water feature system.
- A detention basin will be located on the Cheatum property at 47<sup>th</sup> Avenue and Elliot.
- A trail system along GRIC boundary, connecting the Salt River to several other trails, notably the Laveen Area Conveyance Channel, the Dobbins Road Promenade, and the Western Canal. The trail system will allow for trailheads in South Mountain Park and can be extended along the Salt River to other trailheads and destinations. The connectivity provided by this trail system will facilitate the passage of wildlife and create wildlife corridors.
- Drainage that collects at 67th Avenue will be conveyed north towards the Salt River and south towards the Laveen Area Conveyance Channel in a multi-use channel system.
- A pump station and force main will be located at a detention basin at South Mountain Park and the GRIC boundary to force water northwesterly along the GRIC border, outfalling to Dead Horse Ditch.

#### Engineering Considerations

A detention basin is proposed at the intersection of 43<sup>rd</sup> Avenue and Dobbins Road. The basin has a top area of 10 acres, a bottom area of 3.1 acres, and is 10 feet deep with 5:1 side slopes. This basin will have a metered outflow, not exceeding 20 cfs, to a channel along Dobbins Road. The channel from 43<sup>rd</sup> Avenue to west of 51<sup>st</sup> Avenue will have a bottom width of 5 feet, side slopes of 5:1, and flow 3 feet deep. The channel will discharge to a detention basin west of 51<sup>st</sup> Avenue and Dobbins Road.



The detention basin west of 51<sup>st</sup> Avenue and Dobbins Road has a top area of 10 acres and a 4-acre bottom area. It is 5 feet deep with 5:1 side slopes.

Another detention basin is located at the intersection of Elliot Road and 47<sup>th</sup> Avenue. A channel along the SRP lateral is used as a collector facility and outlets to this detention basin. The basin has a 10-acre top area and a 3.8-acre bottom area. It is 6 feet deep with 5:1 side slopes. The channel that feeds into the basin has an 8 feet wide bottom and 5:1 side slopes. It will have the capacity to carry 320 cfs and flows at a depth of 6 feet.

The detention basin at 47<sup>th</sup> Avenue and Elliot Road will outfall to the detention basin west of 51<sup>st</sup> Avenue and Dobbins by way of a drainage channel. This channel will have a bottom width of 5 feet, flowing 3 feet deep, and have side slopes of 5:1. The flow rate in the channel will not exceed 20 cfs.

Flows outfalling the detention basin at 51<sup>st</sup> Avenue and Dobbins will be conveyed north to detention basin just west of 51<sup>st</sup> Avenue and Baseline Road. The drainage channel connecting the two detention basins will have a bottom width of 5 feet and flow 5 feet deep. The channel will have 5:1 side slopes and have a capacity of 60 cfs.

The detention basin west of 51<sup>st</sup> Avenue and Baseline Road will have a top size of 10 acres and a 3.4-acre bottom. It will be 8 feet deep with 5:1 side slopes. This detention basin will be located in close proximity to the Laveen Area Conveyance Channel and will ultimately outfall to that facility.

Flows that currently collect and inundate 67<sup>th</sup> Avenue will be directed to a drainage channel that will flow south, parallel to 67<sup>th</sup> Avenue, from Southern Avenue to the Laveen Area Conveyance Channel. The 67<sup>th</sup> Avenue Channel will have a bottom width of 10 feet and side slopes of 5:1. The channel will flow at a depth of 5 feet and have a capacity of 205 cfs.

A 20-acre detention basin will be located on the north side of Carver Road, at a wash just west of the Western Canal, to collect flows at that point. The basin will have a volume of 100 acre-feet and be approximately 10 feet deep. The basin will outlet south to 47<sup>th</sup> Avenue and Estrella Drive in a storm drain 36 inches in diameter at a flow rate of 20 cfs. The storm drain outfalls to an existing SRP drainage ditch that heads directly west along Estrella Drive.

This alternative will collect the flows that come off the backside of South Mountain in a 40-acre detention basin. This will prevent existing flows from crossing the reservation boundary and eliminate the frequent flooding problems experienced at the Vee Quiva Casino and at residential areas along 51<sup>st</sup> Avenue (also known as Beltline Drive on the Reservation) in the town of St. Johns. The basin will be sized to hold a volume of 420 acre-feet. The basin will be evacuated through a storm drain pump station and force main system. Discharge rate of the pump station will be 50 cfs (22,500 gpm). The force main will be 20 inches in diameter and approximately 1 mile long. The force main will discharge to the existing drainage ditch running diagonal, parallel to the GRIC boundary (Dead Horse Ditch).

*Environmental Considerations*

A diverse range of cultural resources, from prehistoric villages and canals to historic buildings and roads, are located within the Laveen ADMP study area. As previously described in Part 2, only about 23% of the ADMP area has been evaluated in recent, intense cultural resource survey. Therefore, all of the alternatives have the potential to impact cultural resources, especially in agricultural fields and under roads where subsurface disturbances have been limited to only a few feet. As with each of the alternatives, additional archeological surveys of the area will be expected.

Because of the mostly agricultural nature of activity in the area, there is a relatively small concentration of potential hazardous material sites throughout any of the alternatives. Underground storage tanks are located at several of the major intersections throughout the downtown Laveen area. Only one leaking underground storage tank is located in an area that may conflict with the project at 51<sup>st</sup> Avenue and Dobbins Road. This site is likely to affect all three alternatives equally.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs that programs, policies, and activities not have a disproportionately high and adverse human health and environmental effect on minority and low- income populations. The population in Laveen is comprised of low-income and minority persons. The goal of this project is to improve flood conditions for businesses and residences in the Laveen area. The alternative has the potential to displace residents depending on the final location of the drainage basins and path of the proposed channels. Locations of the basins and channels were determined by creating the best solution based on current, past, and future flooding problems. Therefore, the project is not anticipated to have a disproportionately high or adverse impact on

low-income or minority populations. This project is expected to benefit Laveen residents by providing increased flood protection to the area and increasing recreational opportunities by providing multi-use paths.

Alternative 2A provides by far the features that most favorably meet the environmental goals established by the stakeholders group for wildlife habitat improvement. Because the alternative is based on open channels within linear rights-of-way, opportunities are created for wildlife passage and for habitat enhancement. The channels will serve as corridors for wildlife to have access from the Salt River to South Mountain Park, unimpeded by urban development.

*Multi-use Opportunities*

This alternative offers a variety of trails and detention basins which contribute to the implementation of the planned Laveen Watercourse and Baseline/Dobbins Scenic Drive, support planned trailheads, provide an amenity for the planned Laveen Core and create connections between the Salt River and South Mountain Park.

The Baseline/Dobbins Scenic Drive is supported with a channel proposed along Dobbins Road from 43<sup>rd</sup> Avenue to the Gila River Indian Community Boundary. Basins at 43<sup>rd</sup> and 51<sup>st</sup> Avenue that are associated with this channel will also provide opportunities for open space and recreational areas along Dobbins Road and in the Laveen Town Core. A meandering channel between Elliot Road and the proposed Laveen Area Conveyance Channel contributes to the implementation of the Laveen Watercourse plan. This channel is also associated with basins at Elliot and Baseline Roads. The basins can also provide open space and recreation opportunities at these locations. Channels proposed along Estrella Drive and 67<sup>th</sup> Avenue support planned trails and are also compatible with the planned Laveen Watercourse. A channel between Estrella Drive and Dead Horse Ditch along the Gila River Indian Community border, integrated into a trail between the South Mountain and Salt River, will provide connections between these two amenities.

*Planned Landscape Character Scheme*

The landscape character theme for this alternative provides opportunities to integrate open channels and detention basins into the community through landscaping and design. Generally, the drainage channels would be open, and designed to accommodate shared use trails and equestrians; detention basins would be designed with passive open spaces in the southern portion of the study area and more active turf areas towards the north.



Advantages

- Provides connections between the Laveen Area Conveyance Channel and the Salt River.
- Provides the most recreational opportunities
- Provides most wildlife corridors (Salt River to South Mountain Park)
- Incorporates the Laveen Watercourse Plan
- Addresses GRIC flooding issues
- Provides connections between important recreational resources.
- Contributes to the Implementation of the Baseline/Dobbins Scenic Drive, Laveen Watercourse, and Laveen Town Core
- Provides additional opportunities for parks.
- Implements trails identified in the Phoenix General Plan.

Disadvantages

- Very right-of-way intensive
- High maintenance associated with open areas
- Operating costs associated with pump station
- The best locations for basins may not be coincident with the best locations for parks.

Constraints

- Partnering agreements needed with city of Phoenix and others for multi-use opportunities
- May have local opposition to routing the channel along 51<sup>st</sup> Avenue from Elliot Road to Dobbins Road because of conflicts with existing housing.

Alternative 4

Estimated Cost

Alternative 4 estimated cost = \$23,756,204. Additional costs may be incurred with the incorporation of multi-use infrastructure, which would be funded by organizations other than the District. Refer to Table 14 for a detailed explanation of the estimated costs.

Description

Alternative 4 is the “Storm Drain” alternative. While extensive use of storm drains are used to solve flooding problems, many multi-use opportunities are still provided for along an extensive drainage channel and detention basin system. Notable features of this alternative include:

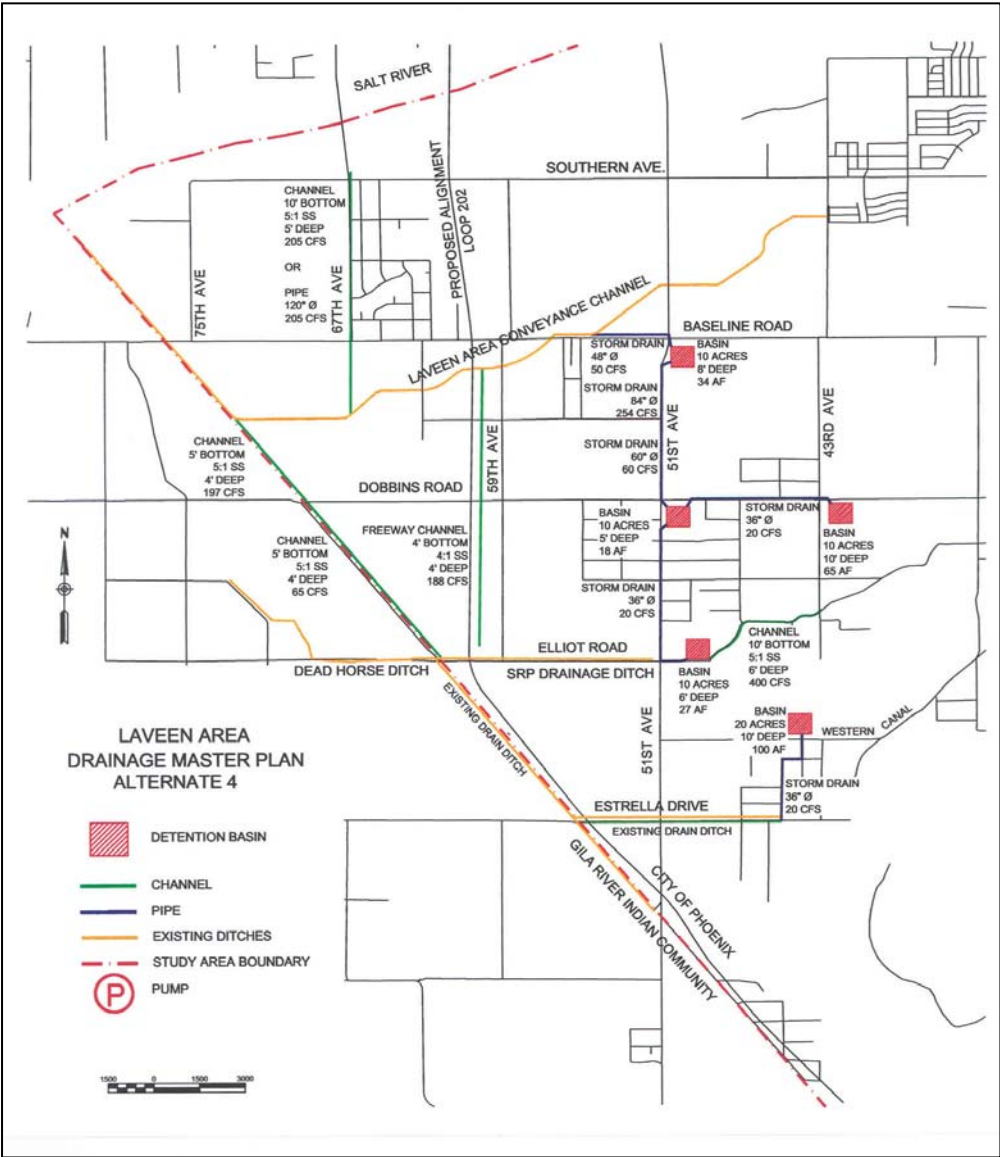


Figure 4-42: Alternative 4, “Storm Drain Concept”

- Multiple-use channels are provided for the Western Canal and for Telegraph Pass.
- Western Canal flows are collected in a detention basin at 43<sup>rd</sup> Avenue, then conveyed west in a channel to the GRIC boundary, outfalling across the reservation.
- Several detention basins will be located in the existing Laveen area to collect flows and to reduce peak discharges before entering the storm drain system.

- Storm drains are proposed to run north along 51<sup>st</sup> Avenue to the Laveen Area Conveyance Channel and west along Dobbins Road to the proposed Loop 202 Transportation corridor.
- The Telegraph Pass channel is conveyed west to the Gila River Indian Reservation.
- South Mountain watershed flows are collected in a detention basin and channeled west or south through the reservation to the Gila River.
- The Western Canal channel runs west to Estrella Drive and then piped north to the Laveen Area Conveyance Channel.
- A storm drain along 67<sup>th</sup> Avenue takes flows north to the Salt River or south to the Laveen Area Conveyance Channel.

Engineering Considerations

A detention basin is proposed at the intersection of 43<sup>rd</sup> Avenue and Dobbins Road. The basin has a top area of 10 acres, a bottom area of 3.1 acres, and is 10 feet deep with 5:1 side slopes. This basin will have a metered outflow, not exceeding 20 cfs, to a storm drain in Dobbins Road. The storm drain from 43<sup>rd</sup> Avenue to 51<sup>st</sup> Avenue will have an inside diameter of 36 inches. The storm drain will discharge to a detention basin at 51<sup>st</sup> Avenue and Dobbins Road.

The detention basin at 51<sup>st</sup> Avenue and Dobbins Road has a top area of 10 acres and a 4-acre bottom area. It is 5 feet deep with 5:1 side slopes.

Another detention basin is located west of the intersection of Elliot Road and 47<sup>th</sup> Avenue. A channel along the SRP lateral is used as a collector facility and outlets to this detention basin. The basin has a 10-acre top area and a 3.8-acre bottom area. It is 6 feet deep with 5:1 side slopes. The channel that feeds into the basin has a 10-foot wide bottom and 5:1 side slopes. It will have the capacity to carry 400 cfs and flows at a depth of 6 feet.

The detention basin west of 47<sup>th</sup> Avenue and Elliot Road will outfall to the detention basin at 51<sup>st</sup> Avenue and Dobbins by way of a storm drain with an inside diameter of 36 inches. The storm drain will have a metered flow rate of 20 cfs.

Flows outfalling the detention basin at 51<sup>st</sup> Avenue and Dobbins will be conveyed north to a detention basin at 51<sup>st</sup> Avenue and Baseline



Road. The storm drain connecting the two detention basins will have an inside diameter of 84 inches and have a capacity of 254 cfs.

The detention basin at 51<sup>st</sup> Avenue and Baseline Road will have a top area of 10 acres and a 3.4-acre bottom. It will be 8 feet deep with 5:1 side slopes. This detention basin will be located approximately one-half mile from the Laveen Area Conveyance Channel and will ultimately outfall to that facility. The outfall will be metered by a 48 inch inside diameter storm drain.

Flows that currently collect and inundate 67<sup>th</sup> Avenue will be directed to a drainage channel that will flow south, parallel to 67<sup>th</sup> Avenue, from Southern Avenue to the Laveen Area Conveyance Channel. The 67<sup>th</sup> Avenue Channel will have a bottom width of 10 feet and side slopes of 5:1. The channel will flow at a depth of 5 feet and have a capacity of 205 cfs.

A 20-acre detention basin will be located on the north side of Carver Road, at a wash just west of the Western Canal, to collect flows at that point. The basin will have a volume of 100 acre-feet and be approximately 10 feet deep. The basin will outlet south to 47<sup>th</sup> Avenue and Estrella Drive in a storm drain 36 inches in diameter at a flow rate of 20 cfs. The storm drain outfalls to an existing SRP drainage ditch that heads directly west along Estrella Drive.

This alternative provides for a drainage channel east of the future Loop 202 Transportation corridor from Elliot Road north to the Laveen Area Conveyance Channel. This is a collector channel that will intercept east to west flows, protecting lands downstream of the transportation corridor alignment. The channel has a bottom width of 4 feet, with 4:1 side slopes and flows at a depth of 4 feet. Channel capacity is 188 cfs.

Another drainage channel will flow diagonally along the boundary with the Gila River Indian Reservation from Elliot Road northwest to where it will intersect with the Laveen Area Conveyance Channel, at approximately the extension of Olney Avenue. This channel will have bottom width of 5 feet and side slopes of 5:1. Depth of flow will be 4 feet and the flow rate will be 197 cfs.

*Environmental Considerations*

A diverse range of cultural resources, from prehistoric villages and canals to historic buildings and roads, are located within the Laveen ADMP project area. As previously described in Part 2, only about 23% of the ADMP area has been evaluated in recent, intense cultural resource survey. Therefore, all of the alternatives have the potential

to impact cultural resources, especially in agricultural fields and under roads where subsurface disturbances have been limited to only a few feet. As with each of the alternatives, additional archeological surveys of the area will be expected.

Because of the mostly agricultural nature of activity in the area, there is a relatively small concentration of potential hazardous material sites throughout any of the alternatives. Underground storage tanks are located at several of the major intersections throughout the downtown Laveen area. Only one leaking underground storage tank is located in an area that may conflict with the project at 51<sup>st</sup> Avenue and Dobbins Road. This site is likely to affect all three alternatives equally.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs that programs, policies, and activities not have a disproportionately high and adverse human health and environmental effect on minority and low-income populations. The population in Laveen is comprised of low-income and minority persons. The goal of this project is to improve flood conditions for businesses and residences in the Laveen area. The alternative has the potential to displace residents depending on the final location of the proposed drainage basins. Locations of the basins were determined by creating the best solution based on current, past, and future flooding problems. Therefore, the project is not anticipated to have a disproportionately high or adverse impact on low-income or minority populations. This project is expected to benefit Laveen residents by providing increased flood protection to the area and increasing recreational opportunities by providing multi-use paths.

Because a significant portion of this alternative is below ground, i.e. in storm drains, the opportunity for supporting wildlife habitat by creating corridors in linear easements is somewhat limited. This alternative does however provide for large open spaces in the system of detention basins. A portion of the basins may be designed to promote wildlife, either by serving as habitat or interpretive centers.

*Multi-use Opportunities*

This alternative focuses on pipes and basins. Because pipes would be underground, this alternative does little to support the implementation of the Laveen Watercourse Plan or trails proposed in the Phoenix General Plan. Basins, located along 51<sup>st</sup> Avenue at Baseline and Dobbins Roads, at 43<sup>rd</sup> Avenue and Dobbins Road and at approximately 43<sup>rd</sup> Avenue and Carver Road provide opportunities for open spaces without connections to the wider planned trail system. Another basin, located along Elliot Road could be integrated

into the General Plan and Laveen Watercourse Plan trail system. Landscaped channels between Elliot Road and the Laveen Area Conveyance Channel, the Laveen Area Conveyance Channel and the Salt River and along the Gila River Indian Community border provide connections between the planned Baseline/Dobbins Scenic Drive and the Salt River.

*Planned Landscape Character Scheme*

All but one basin in this alternative is located in the agriculture landscape character area, and would be designed with an agricultural theme. This theme envisions basins as nodes with passive open space and linear trail connections. Similarly, the channels between the Laveen Area Conveyance Channel and Elliot Road would be designed to an agricultural theme. The proposed channels along Estrella Drive and Elliot Road are associated with a natural desert theme, and the Channel along 67<sup>th</sup> Avenue north of the Laveen Area Conveyance Channel is associated with a transitional theme.

*Advantages*

- Very little right-of-way is required for conveyance system.
- Provides opportunities for open spaces.
- Provides some north-south trail connections.

*Disadvantages*

- Does not protect the Gila River Indian Community.
- Does not provide for wildlife habitat or corridors.
- Does not implement the Laveen Watercourse, Town Core, Baseline/Dobbins Scenic Drive or Phoenix General Plan.
- Does not provide linkages for open space/recreation opportunities associated with basins.
- Basin locations may not be coincident with the preferred locations for parks.

*Constraints*

- Coordination required with ADOT for the proposed Loop 202 Transportation corridor channel.
- Does not take into account the planned Laveen Core area



**Alternative 6**

*Estimated Cost*

Alternative 6 estimated cost = \$21,485,345. Additional costs may be incurred with the incorporation of multi-use infrastructure, which would be funded by organizations other than the District. Refer to Table 15 for a detailed explanation of the estimated costs.

*Description*

- Alternative 6 is similar to the Alternative 6 described in Part 3 of this report, described as the “Minimal Structural” alternative. It has been refined slightly to allow for practical hydrologic and hydraulic considerations. It provides for the least amount of infrastructure necessary to provide 100-year flood protection and minimizes the possibilities for recreation and shared use facilities that could be provided in combination with flood control improvements. Minor flooding is not addressed and opportunities for multiple uses within the flood control solutions are minimized. Features of this alternative include:
- A collector channel is placed behind the Western Canal to capture and convey flows to basins near 43<sup>rd</sup> and 47<sup>th</sup> Avenues to protect 43<sup>rd</sup> to 51<sup>st</sup> Avenue flooding areas.
- Storm drains placed within the Laveen Core convey flows to 51<sup>st</sup> Avenue, then ultimately to the Laveen Area Conveyance Channel to protect the Laveen Elementary School as well as existing Laveen.
- A basin at 51<sup>st</sup> Avenue and Baseline Road is planned to detain flows and reduce peak discharges into the Laveen Area Conveyance Channel.
- Storm flows from along Telegraph Pass will be collected and conveyed via a channel to a detention basin, then outfall west into existing Dead Horse Ditch

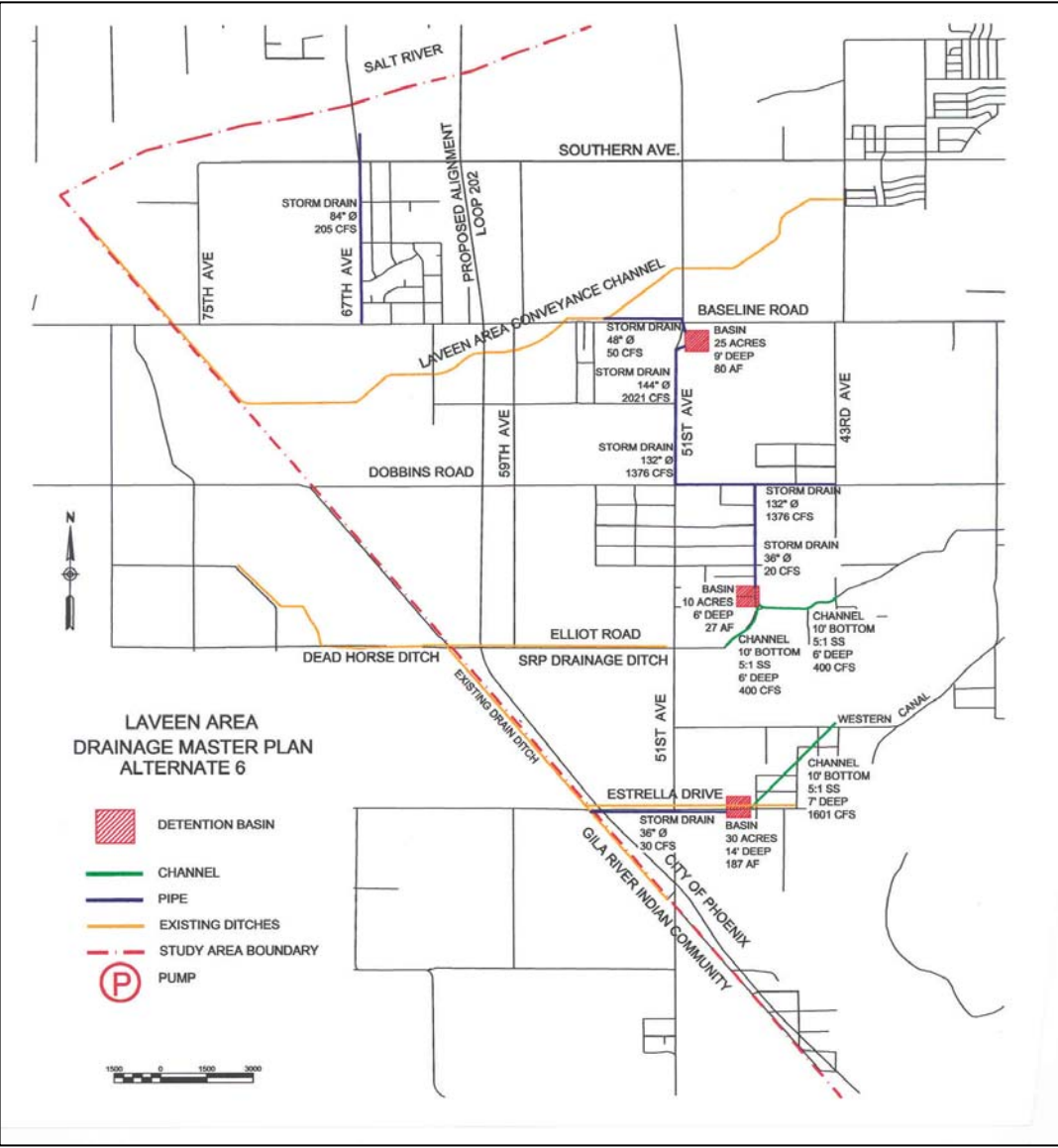


Figure 4-43: Aternative 4, “Storm Drain Concept

- The possibilities for recreation and other multi-use opportunities, in combination with flood control improvements are minimized.

*Engineering Considerations*

A storm drain is proposed starting at the intersection of 43<sup>rd</sup> Avenue and Dobbins Road. The storm drain will have a capacity of 1376 cfs, and an inside diameter of 132 inches. The storm drain will flow west to 51<sup>st</sup> Avenue and Dobbins. From there, the storm drain turns north along 51<sup>st</sup> Avenue to a detention basin at the intersection of 51<sup>st</sup> Avenue and Baseline Road. The storm drain along this reach has an inside diameter of 144 inches and a flow capacity of 2021 cfs.

The addition of a detention basin(s) at 43<sup>rd</sup> Avenue and Dobbins, or increasing the size of the detention basin at 51<sup>st</sup> Avenue and Dobbins will greatly reduce the stated sizes for the storm drains.

The detention basin at 51<sup>st</sup> Avenue and Baseline Road will have a top area of 25 acres and a 3.3-acre bottom. It will be 9 feet deep with 5:1 side slopes. This detention basin will be located approximately one-half mile from the Laveen Area Conveyance Channel and will ultimately outfall to that facility. The outfall will be metered by a 48 inch inside diameter storm drain with a flow rate of 50 cfs.

Another detention basin is located at the intersection of Elliot Road and 47<sup>th</sup> Avenue. A channel along the SRP lateral is used as a collector facility and outlets to this detention basin. The basin has a 10-acre top area and a 3.8-acre bottom area. It is 6 feet deep with 5:1 side slopes. The channel that feeds into basin has a 10-foot wide bottom and 5:1 side slopes. It will have the capacity to carry 400 cfs and flows at a depth of 6 feet.

The detention basin at 47<sup>th</sup> Avenue and Elliot Road will outfall to the storm drain in Dobbins Road a storm drain in 47<sup>th</sup> Avenue. The storm drain has an inside diameter of 36 inches. The storm drain will have a metered flow rate of 20 cfs.

Flows that currently collect and inundate 67<sup>th</sup> Avenue will be directed to the Salt River in a storm drain that will flow north, parallel to 67<sup>th</sup> Avenue, from Baseline Road to north of Southern Avenue. The 67<sup>th</sup> Avenue storm drain will have an inside diameter of 84 inches and have a capacity of 205 cfs.



A drainage channel will be located from Carver Road, southwest along a wash to Estrella Drive, to collect and control flows. The channel will have a bottom width of 10 feet, with 5 to 1 side slopes. The channel will flow 7 feet deep and have a capacity of 1600 cfs. The channel will flow into a detention basin at approximately 47<sup>th</sup> Avenue and Estrella Drive.

The detention basin at 47<sup>th</sup> Avenue and Estrella Drive will have a volume of 187 acre-feet and be approximately 14 feet deep. It has a top area of 30 acres and a bottom area of 2.45 acres. The detention basin will outlet west to a storm drain in Estrella Drive. The storm drain is 36 inches in diameter and has a flow rate of 30 cfs. The storm drain ultimately discharges to an existing SRP drainage ditch that heads directly west along Estrella Drive.

*Environmental Considerations*

A diverse range of cultural resources, from prehistoric villages and canals to historic buildings and roads, are located within the Laveen ADMP project area. As previously described in Part 2, only about 23% of the ADMP area has been evaluated in recent, intense cultural resource survey. Therefore, all of the alternatives have the potential to impact cultural resources, especially in agricultural fields and under roads where subsurface disturbances have been limited to only a few feet. As with each of the alternatives, additional archeological surveys of the area will be expected.

Because of the mostly agricultural nature of activity in the area, there is a relatively small concentration of potential hazardous material sites throughout any of the alternatives. Underground storage tanks are located at several of the major intersections throughout the downtown Laveen area. Only one leaking underground storage tank is located in an area that may conflict with the project at 51<sup>st</sup> Avenue and Dobbins. This site is likely to affect all three alternatives equally.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs that programs, policies, and activities not have a disproportionately high and adverse human health and environmental effect on minority and low-income populations. The population in Laveen is comprised of low-income and minority persons. The goal of this project is to improve flood conditions for businesses and residences in the Laveen area. The alternative has the potential to displace residents depending on the final location of the proposed drainage basins. Locations of the basins were determined by creating the best solution based on current, past, and future flooding problems. Therefore, the project is not anticipated to have a disproportionately high or adverse impact on low-income or minority populations. This project is expected to benefit Laveen residents by providing increased flood protection to the area and increasing recreational opportunities by providing multi-use paths.

Because a significant portion of this alternative is below ground, i.e. in storm drains, the opportunity for supporting wildlife habitat by creating corridors in linear easements is somewhat limited. This alternative does however provide for large open spaces in the system of detention basins. A portion of the basins may be designed to promote wildlife, either by serving as habitat or interpretive centers.

*Multi-use Opportunities*

Because this alternative uses the least amount of intervention to manage stormwater, it also offers the fewest opportunities for recreation associated with stormwater management facilities. Detention basins at 51<sup>st</sup> Avenue and Baseline Road, Elliot Road and 47<sup>th</sup> Avenue, and Estrella Drive and 43<sup>rd</sup> Avenue offer open space opportunities associated with trails planned along the Laveen Area Conveyance Channel, Lateral 14, and the Telegraph Pass Canals. This alternative does not contribute to the implementation of the Laveen Watercourse, Town Core, South Mountain Trails, or Baseline/Dobbins Scenic Drive plans.

*Planned Landscape Character Scheme*

The majority of the landscape character associated with this theme is associated with detention basins. Natural re-vegetation is recommended along channels at Elliot Road and Estrella Drive.

*Advantages*

- Minimum maintenance efforts required.
- Minimum amount of new right-of-way required.
- Minimum disturbance to the existing landscapes.

*Disadvantages*

- Very large diameter storm drains are required.
- Does not provide for trail connections.
- Does not provide for wildlife habitat or corridors.
- Does not contribute to the implementation of existing plans.
- Does not provide connections between South Mountain and Salt River.
- Does not provide flood protection for Gila River Indian Community.

*Constraints*

- Does not take into account the planned Laveen Core area.



EVALUATION OF ALTERNATIVES

Each of the three alternatives has been evaluated with respect to the specific criteria discussed below. The results of the evaluation process have yielded the preferred alternative that will be carried forth to conceptual level design.

Method of Evaluation

A four-step method of evaluating the alternatives was developed. In order to evaluate the alternatives objectively, the methodology was carefully designed to allow fair and open participation among the evaluators.

The four basic steps are:

- Determine who are to be the evaluators, and what weight will be given to their respective evaluation scores.
- Determine the evaluation criteria for the alternatives, and what weight will be given for each criteria.
- Rate how each alternative measures against the criteria, and
- Summarize and present the results.

Evaluators

In order to include as many voices in the evaluation process as possible, the study team members have listed the stakeholders and ranked them into tiers based on their level of involvement or interest in the study. The areas considered include financial, quality of life, and public safety. Financial interests include primarily those stakeholders viewed as funding partners. Quality of life relates to those who will live with the long-term results of the alternative, and public safety involves those who are charged with the ongoing and continued success of the alternative. Following, is a table that illustrates and summarizes this analysis.

Table 13: Stakeholder tiers ranking system

TIER 1	TIER 2
Laveen Residents City of Phoenix SRP FCDMC	MCDOT ADOT GRIC

Evaluation Criteria

The evaluation criteria have been defined based upon the goals and objectives established for the Laveen ADMP at the Alternatives Formulation meeting held February 1<sup>st</sup>, 2001. Weights have been applied to the significance of each criteria, by comparing the preferences of the various stakeholders. The study team members in individual stakeholder meetings undertook the effort to solicit and compare criteria preferences. The following discusses the criteria used to evaluate the alternatives:

Capital Cost

Capital cost is the initial cost of the project. This cost considers construction equipment, materials and labor, right-of-way acquisition and site mitigation, utility protection and relocation, design engineering, and contingencies including permitting and other miscellaneous costs. Costs related to ongoing operation and maintenance are not addressed here, but are discussed under maintenance criteria. Because the capital cost of each alternative is being compared relative to the other alternatives, it is not necessary to estimate future construction costs. Present day unit costs have been used based upon recent bid tabulations for large projects in the Phoenix metropolitan area.

A score of plus one is assigned to the alternative with the lowest capital cost. A score of minus is assigned to the alternative with the highest first cost. The remaining alternative receives a score of zero.

Multiple-Use Opportunities

The alternative that would create the most multi-use opportunities, provide for recreational amenities, develop links between public transportation facilities and routes, and benefits adjacent property owners the most is assigned a score of plus one. A score of minus one is given to the alternative with the fewest multi-use opportunities, limited recreation amenities, lacks the potential to link public transportation facilities and routes, requires substantial relocation of residences, and/or negatively affects adjacent property owners.

Acceptability to Local Residents

The acceptability of a flood control project by the residents, landowners, and developers is important to the overall success of the project. A score of plus one is assigned to the alternative that would be most acceptable to the public in terms of land acquisitions, visual quality, recreational benefit, and overall flood protection. A score of minus one is assigned to the alternative that would be least acceptable to the public.

Acceptability to Public Agencies

Similar to the above criteria, the acceptability of a flood control alternative by the public agencies charged with constructing, operating, and maintaining the facility, both from a storm drainage master planning point of view and from a multi-use opportunity point of view is essential to a successful project. A score of plus one is assigned to the alternative that is most acceptable to public agencies. A score of minus one is assigned to the alternative with the most public agency resistance.

Environmental Impacts

These environmental considerations refer to the potential impacts to areas of high habitat value, high historic and cultural value, and wildlife opportunities. A score of plus one is assigned to the alternative(s) that will protect areas of high habitat or historic value and provide for the opportunity to enhance and/or create habitat. A score of minus one would be assigned to the alternative having the most negative impacts on the physical, natural, and cultural considerations, and provide the fewest opportunities to enhance wildlife.

Maintenance

Maintenance refers to the annual cost for maintaining and operating the flood control facility. Frequency of maintenance and difficulty of access affect annual maintenance costs. A score of plus is assigned to projects with the lowest maintenance cost. A score of minus one is assigned to projects with the highest annual maintenance cost.

Implementation

Opportunities to partner with an agency such as ADOT, the city of Phoenix, MCDOT, GRIC or SRP are beneficial to both the District and the partnering agency. Initial costs as well as annual maintenance can be shared, and the community realizes long-term benefits to both flood control and to the recreational aspects of the facilities. A score of plus one is assigned to the alternative with the best opportunity for partnering and cost sharing. A score of minus one is assigned to the alternative with the least opportunity for partnering and cost sharing.

Appropriate to Landscape

This criteria refers to the opportunity to either preserve existing desirable landscape character or improve the aesthetics and visual character of the study area. A score of plus one is assigned to the alternative that will provide for the greatest opportunity to enhance aesthetics. A score of minus one would have the most negative



impacts on the physical and natural considerations, and provide the fewest opportunities to enhance aesthetics.

Evaluation Matrix

The evaluation matrices in Figures 4-43 and 4-44 show the weights of the evaluation criteria and the resulting ranks of the three alternatives. Blank copies of Figure 4-43 were distributed to the stakeholders at individual meetings. Each person representing a stakeholder group or entity completed these forms to determine the preferred alternative for their group.

The weight values for each criterion were determined by comparing each criterion against each other. Each one of the criteria on the first column was compared to each of those listed on the first row. If the evaluator favored one aspect over the other, a “+” was assigned. No preference of one over the other, was assigned a “0”, while a “-” was assigned for less preference of one over the other. A numerical value corresponding to each symbol was utilized to calculate a weighted multiplier used in the evaluation of alternatives for each stakeholder group.

		A	B	C	D	E	F	G	H	
		Capital Cost	Multi-Use Opportunities	Acceptability to Local Residents	Acceptability to Public Agencies	Environmental Impacts	Maintenance	Implementation	Appropriate to Landscape	Weights
A	Capital Cost		+	-	0	0	+	-	0	0.19
B	Multi-Use Opportunities			0	-	0	+	-	+	0.17
C	Acceptability to Local Residents				0	-	0	-	-	0.12
D	Acceptability to Public Agencies					0	+	0	+	0.16
E	Environmental Impacts						+	-	+	0.13
F	Maintenance							-	+	0.08
G	Implementation								+	0.12
H	Appropriate to Landscape									0.04

- + = Strong Preference
- 0 = No preference
- = Less Preference

Figure 4-44: Criteria Evaluation Matrix

Based on the stakeholders’ level of involvement, or tier, their selected alternative was multiplied by a “stakeholder tier factor”. This factor was previously calculated by evaluating the stakeholders with each other using the same procedure that was utilized in the evaluation criteria comparison. The total scores were summed and the alternative receiving the highest score was selected as the preferred alternative.

The evaluations have been performed at individual review meetings with the stakeholder groups. At the meetings, an overview of the three screened alternatives and the evaluation process was presented. Opportunity was provided for questions and discussion. Following the discussion, the evaluation forms were completed. The scores were tabulated with the aid of a laptop.

		Alt 2A	Alt 4	Alt 6
A	Capital Cost			
		Rank		
		Weight	0.19	0.19
		0	0	0
B	Multi-Use Opportunities			
		Rank		
		Weight	0.17	0.17
		0	0	0
D	Acceptability to Local Residents			
		Rank		
		Weight	0.12	0.12
		0	0	0
E	Environmental Impacts			
		Rank		
		Weight	0.16	0.16
		0	0	0
F	Maintenance			
		Rank		
		Weight	0.13	0.13
		0	0	0
G	Implementation			
		Rank		
		Weight	0.08	0.08
		0	0	0
H	Appropriate to Landscape			
		Rank		
		Weight	0.12	0.12
		0	0	0
Total Score		0	0	0
Weighted Totals		#DIV/0!	#DIV/0!	#DIV/0!

- Rank
- +1 = Most preferable for selected criteria
- 0 = Preferable
- 1 = Least preferable for selected criteria

Figure 4-45: Alternatives Evaluation Matrix